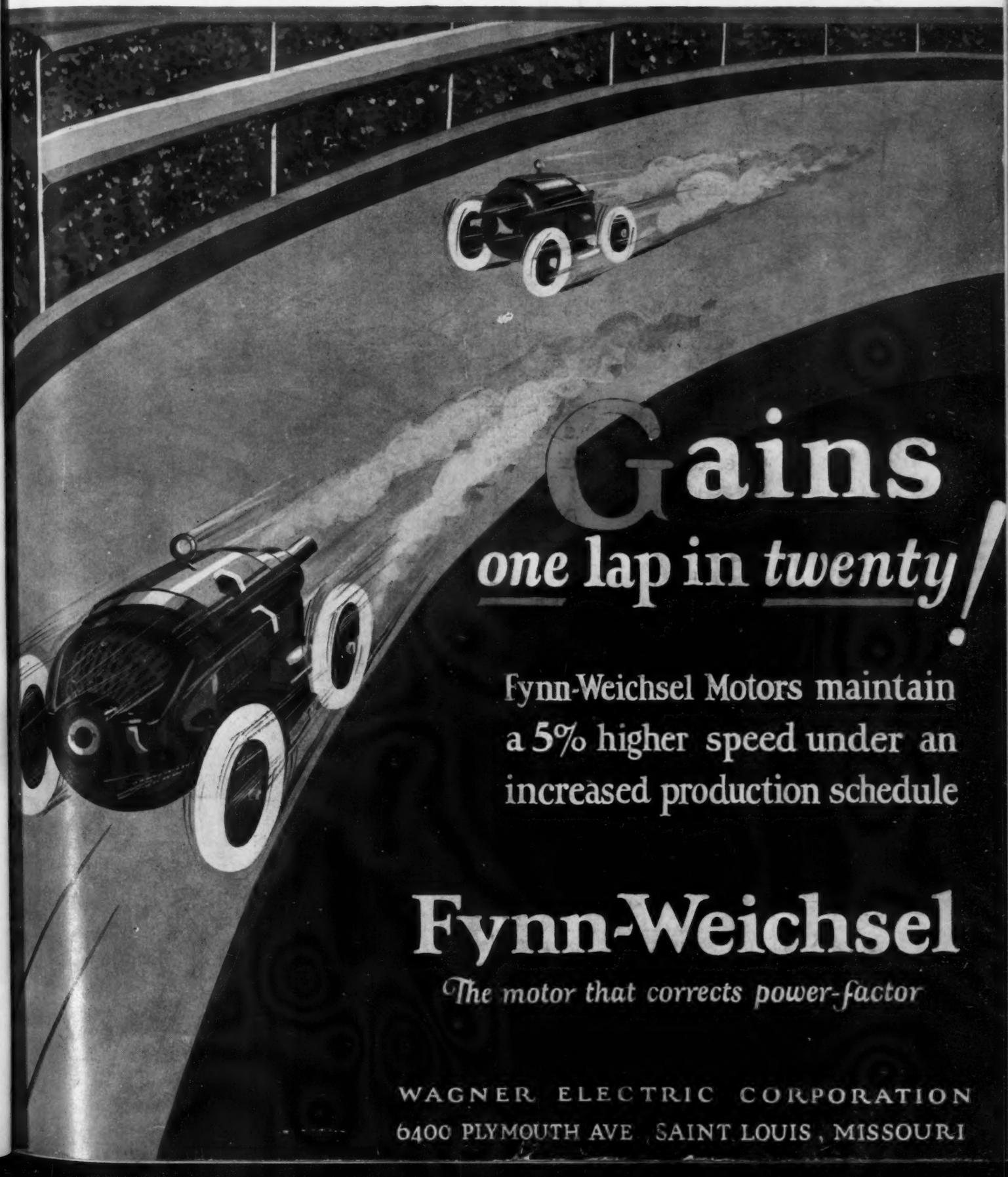
Founded 1874—Fifty-Two Years of Service

Engineering and

Electrical World

McGraw-Hill Publishing Company, Inc. January 15, 1927 Twenty-five Cents Per Copy

JAN 17 1927

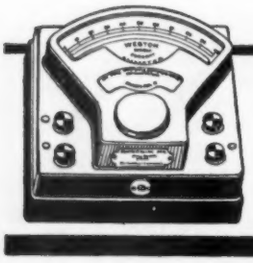

Gains
one lap in twenty!
Fynn-Weichsel Motors maintain a 5% higher speed under an increased production schedule
Fynn-Weichsel
The motor that corrects power-factor
WAGNER ELECTRIC CORPORATION
6400 PLYMOUTH AVE SAINT LOUIS, MISSOURI

WESTON
for ACCURATE Portable Testing

OPERATING executives can send their test men or engineers out into the plant or along the line with absolute assurance that electrical maintenance will best be served if they carry "Weston Jr." instruments. ¶"Weston Jr." instruments, because of their high dependability and long-time performance, are regarded by their individual users as the instruments upon which they can safely trust their work and their reputations. They know by intimate use, that Weston never places its name upon an instrument unless it is sure of its outstanding superiority. ¶"Weston Jr." instruments are used for power line work and general all-around testing, to check the efficiency of motors and all types of electrical equipment.

"WESTON JUNIOR" INSTRUMENTS are made as A. C. Voltmeters and Ammeters in single and double ranges and Wattmeters for single phase alternating and direct current. Compact, light in weight, ruggedly encased in Bakelite.

WESTON ELECTRICAL INSTRUMENT CORPORATION
13 Weston Avenue, Newark, N. J.



STANDARD THE WORLD OVER

WESTON

Pioneers since 1888

Vol. 89, No. 3 New York, January 15, 1927 *Pages 133-184*

L. W. W. MORROW
Managing Editor
EARL E. WHITEHORNE
Commercial Editor
ALLEN M. PERRY
Associate Editor
G. F. WITTIG
Statistical Editor
H. M. CAMERON
Financial Editor
F. C. WELLS
News Editor
EUSTACE C. SOARES
Manufacturing and Markets Editor
L. H. CHURCH
Assistant Editor

Electrical World

The Consolidation of Electrical World, Electrical Engineer and American Electrician

W. H. ONKEN, JR., *Editor*

FRANK R. INNES
Western Editor
7 South Dearborn St., Chicago
H. S. KNOWLTON
New England Editor
88 Tremont St., Boston
WALTER C. HESTON
Pacific Coast Editor
883 Mission St., San Francisco
T. P. KINDIG
Assistant Editor
401 Guardian Bldg., Cleveland
PAUL WOOTON
Washington Correspondent
Colorado Bldg., Washington
R. L. SHEPHERD
Southern Editor
Alabama Power Co. Bldg.
Birmingham

CONTENTS

Editorials 133

Frontispiece—Commercial Transatlantic Radio Telephone Started 136

Improving Conductor Alloys 137
By M. G. CORSON.

Electric Melting of Gray Iron Saves $30 Per Ton 139
By J. L. FADEN.

Stability Characteristics of Machines 141
By R. D. EVANS AND C. F. WAGNER.

Construction Features in Metropolitan Substations 144

The Narragansett-Attleboro Decision 146
By CARL D. JACKSON.

Electrical Committee Formed by League of Nations 146

Problems of Codification and Standardization 147
By IRVIN W. DAY.

October Energy Output Exceeds 6,000,000,000 Kw.-Hr. 148

Letters from Our Readers 150

Central Station and Industrial Practice 152

Commercial Activities and Public Relations 156

Digest of Electrical Literature 159

News of the Industry 161

Men of the Industry 168

Court Decisions, Commission Rulings 170

Financial and Corporate 171

Manufacturing and Markets 175

New Equipment Available 179

Construction News 180

Electrical Patents 182

Business Facts for Electrical Men 183

McGRAW-HILL PUBLISHING COMPANY, INC.
Tenth Ave. at 36th St., NEW YORK, N. Y.

JAMES H. MCGRAW, President
JAMES H. MCGRAW, JR., V.-Pres. and Treas.
MALCOLM MUIR, Vice-President
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
C. H. THOMPSON, Secretary

WASHINGTON, Colorado Building
CHICAGO, 7 South Dearborn St.
PHILADELPHIA, 1600 Arch St.
CLEVELAND, Guardian Building
ST. LOUIS, Star Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie Street, London, E. C. 4

Cable Address "Machinist, N. Y."
The annual subscription rate is $5 in the United States, Canada, Mexico, Alaska, Hawaii, Philippines, Porto Rico, Canal Zone, Honduras, Cuba, Nicaragua, Peru, Colombia, Bolivia, Dominican Republic, Panama, El Salvador, Argentina, Brazil, Spain, Uruguay, Costa Rica, Ecuador, Guatemala, Haiti and Paraguay. Extra foreign postage, $4 (total $9 or 38 shillings). Subscriptions may be sent to the New York office or to the London office. Single copies, postage prepaid to any part of the world, 25 cents.

Change of Address — When change of address is ordered the *new* and the *old* address must be given. Notice must be received at least ten days before the change takes place.

Copyright 1926
By McGraw-Hill Publishing Company, Inc.

Published weekly
Entered as second-class matter Jan. 20, 1907, at the Post Office at New York, N. Y., under the Act of March 3, 1879.
Printed in U. S. A.

Circulation of this issue, 19,725

Publishers of
Engineering News-Record — American Machinist
Power — Chemical and Metallurgical Engineering
Coal Age — Engineering and Mining Journal
Ingeniería Internacional — Successful Methods
Bus Transportation — Electric Railway Journal
Electrical World — Electrical Merchandising
Industrial Engineer — Radio Retailing
Electrical West
(Published in San Francisco)
American Machinist—European Edition
Published in London

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

Who Pays for

Editorial Service?

ONCE in a great while readers of the ELECTRICAL WORLD, like readers of other magazines, are heard to ask: "Why do we have to put up with a mass of advertising in which the reading matter, for which we pay, is buried?" There are at least two reasons.

In the first place, most readers profit greatly by reading advertisements that pertain to their actual or possible needs. In the field of technical and business papers advertising affords a means of keeping abreast of improvements, developments and progress that may save many dollars for the reader. Modern industrial advance is based on it.

In the second place, it would be impossible to provide editorial service of the caliber now rendered at the present price if an income from the advertising were not available for directing and conducting editorial work and converting its results into published form. Subscription prices to magazines and papers rendering a high-grade editorial service seldom cover one-fifth of the production cost and sometimes cover less. What subscriber would be willing to have his subscription price multiplied by five?

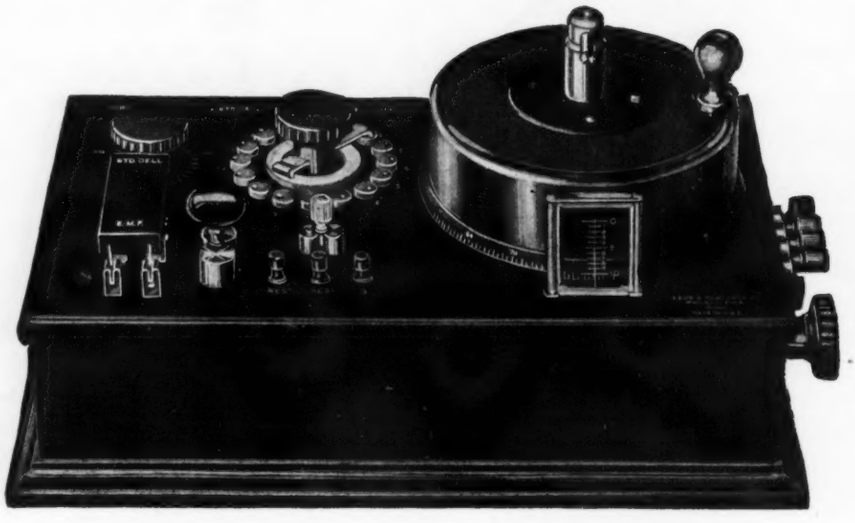
For these reasons subscribers will, on reflection, feel glad that advertising pages do envelop the reading matter. The deeper the "burying," the more the money that can be spent to give editorial service. For example, if no advertising had been carried in the issue of the ELECTRICAL WORLD for January 1, with its record of progress and wealth of statistics, it would have been necessary to sell it for $5 a copy—the price of a year's subscription. Would those who grumble about the advertising pages have been willing to pay so much?

Advertising Index—Alphabetical, 98; Classified, 92, 94, 96; Directory of Engineers, 46, 47; Searchlight Section, 48-54

The Type K Potentiometer

In Use in the Large Majority of Meter Standardizing Laboratories in America

For Precise Instrument Calibration



An *Important* Feature

THE design of the Type K Potentiometer is such that its accuracy can be determined to the nearest .01 per cent with ordinary instruments available in any standardizing laboratory. Accordingly the user need never be in doubt about the accuracy of his Type K Potentiometer.

7551 TYPE K POTENTIOMETER.....$275.00

Write for Bulletin W-755

LEEDS & NORTHRUP COMPANY
4901 STENTON AVENUE, PHILADELPHIA

LEEDS & NORTHRUP

Galvanometers
Potentiometers
Bridges and Resistances
Condensers and Inductances
Testing Sets
Recording and Controlling Pyrometers
Hump and Homo Electric Heat Treating Furnaces
Instruments for Measuring and Controlling Conductivity of Electrolytes and Hydrogen Ion Concentrations

G-1

Electrical World

Published by McGraw-Hill Publishing Company, Inc.
W. H. ONKEN, JR.
Editor

VOLUME 89 — *New York, Saturday, January 15, 1927* — NUMBER 3

Why Should Buyers of Energy Pay All the Cost of Improving Rivers?

THERE seems to be a very general impression that where electricity can be generated at a dam built across a navigable stream the cost of the dam may be included in the rate structure and thus be shouldered on the users of the electric service. It is true that many hydro-electric developments have been so built, notwithstanding that the dams serve a very necessary and useful purpose either for navigation or for flood control. Obviously this is an imposition on electrical consumers.

Consider, for example, the proposed developments on the St. Lawrence and Colorado Rivers. The primary function of the first is navigation and the primary functions of the second are flood control and irrigation. All of these are governmental functions, and the cost should be borne by the national government. If electricity can also be generated, only that part of the investment necessary to power production and not the whole cost of the dam should be charged to the company leasing the power rights. What paramount interest has the ultimate consumer of electrical energy in navigation or flood control that he should relieve the government of the expense of such public work? The electrical industry believes in and practices real co-operation, but co-operation ceases to be co-operation when it is altogether one-sided. It is contended by some business interests at the port of New York that the navigation features contained in the plan favored by the United States and international St. Lawrence commissions would be a detriment to that port. If the project were put through and these misgivings proved well founded, consumers of St. Lawrence power in the metropolitan district would be charged in part for an investment that redounded to their injury. In other instances, as at Keokuk, the return from water-power plants might be greater and the rates less were they not burdened with charges for accompanying developments from which their owners derive no benefit as makers of power.

Federal Regulation Should Be a Last Resort

"I AM in favor of reducing, rather than expanding, government bureaus which seek to regulate and control the business activities of the people. Every one is aware that abuses exist and will exist so long as we are limited by human imperfections. Unfortunately, human nature cannot be changed by an act of the Legislature." These words from President Coolidge's recent message to Congress strike a responsive chord in the thinking of well-informed persons whether within or without the electrical industry. The principle is pre-eminently applicable to the national government. The rise of interstate power transmission has focused attention upon regulative problems and afforded opportunity for ill-advised agitation by political self-seekers and well-intentioned but misinformed public men in favor of centering more and more power at the national capital.

Fortunately, a great deal of work has been done of late to acquaint the public with the wisdom of exhausting the possibilities of local regulation, by the industry itself or by state commissions, before buying commutation tickets to Washington. Secretary Hoover's championship of state regulation has also been masterly, and his favorable comments at the recent Providence meeting of the New England Council upon the plan for joint commission jurisdiction over interstate power contracts have attracted wide attention. As the President said to Congress: "Permanent success lies in local rather than in national action. Unless the locality rises to its own requirements there is an almost irresistible impulse for the national government to intervene. The states and the nation should both realize that such action is to be adopted only as a last resort."

In view of the decision of the Supreme Court in the Attleboro case and its pertinence to the question of state versus federal regulation, the ELECTRICAL WORLD publishes on page 146 an opinion prepared at its request by Carl Jackson. A careful reading of that opinion confirms the impression that state commissions, acting co-operatively, are better qualified to regulate what little interstate business exists, and that the President and the Secretary of Commerce not only voice sound public policy but that their attitude is also in keeping with the best thought of the electric public utility industry.

Science Is Marching On

IT IS only eighty-three years since the world marveled over the operation of Morse's telegraph between Washington and Baltimore—many a person then alive is in physical and mental vigor today. It is only seventy years since Field laid his first cable under the Atlantic, only fifty since Bell demonstrated his telephone at Philadelphia, only twenty-five since Marconi signaled from England to Newfoundland, and less than twelve since the human voice was first heard across the sea. Each new advance in communication by electricity has exceeded its predecessor, but as the achievement has grown greater the astonishment has grown less. Last week the first non-experimental conversation between America and Europe took place, and, though popular interest in the event was intense, there was no astonishment at all. Every one now expects of science a weekly miracle, and in place of the crass incredulity and scornful skepticism of former generations, men today are prone to lend a trustful ear alike to true prophets and to false—to the scientist and to the charlatan.

In this latest triumph of long-distance communication hearing is believing. Although ringing up Europe, like

ringing up far-distant cities at home, is likely to remain for years to come largely the prerogative of business big enough to have the price, perhaps, with perfected equipment and assured income, this will not always be so. For the ordinary citizen a three-thousand-mile conversation—eastward or westward—will remain for the present a real adventure, like an airplane ride, to be undergone, if ever, once or twice in a lifetime and remembered ever afterward with a thrill; but to bring the price eventually within the reach of all will undoubtedly be the goal—however far off—of the telephone companies and governments concerned. The chain of vocal communication will before many years extend to the Antipodes and back again. A great influence on human progress will no doubt be exerted even by a limited use of the international talking apparatus, confined to diplomatists, financiers and wealthy cosmopolites, but how much greater it would be if, for instance, every dweller in America who came originally from a foreign land or who has friends domiciled abroad could call up his old home town or his migratory compatriots. or answer their calls, as readily and with as little sense of the unusual as he now rings the other side of the city where he dwells! The waves of the ether may yet unite what the waves of the seas now sunder.

Knowledge of Merchandising Methods Develops Export Markets

KNOWLEDGE of market possibilities is the first essential information which a manufacturer desires, whether it be in the domestic or the foreign field. With it as a basis many new markets can be developed if the electrical manufacturer will apply logical and sustained sales efforts and will fortify his actions with complete information regarding the merchandising methods of the country whose business he is seeking.

The Bureau of Foreign and Domestic Commerce affords such information. It is primarily a sales organization, and in its sales-promotion work it collects, through its personal representatives in the various parts of the world, basic data on the marketing conditions in many countries. This information is available to all organizations requesting it. The bureau also disseminates periodically all current market information affecting the export of American goods.

The electrical equipment division of the bureau is probably thought of first by the electrical industry, but in the other divisions also there is available much information of value to the electrical manufacturer. For instance, the commercial laws division can furnish data covering the various legal phases of exporting to all countries of the world, including trademarks and similar items. The tariff division has complete information covering the tariffs imposed by all countries and can supply virtually any information an exporter may request on this subject. The commercial intelligence division can furnish world-trade directory reports on nearly all important foreign companies and is prepared to supply the names of prospective agents abroad for American exporters, with information as to the class of apparatus or the type of business they are handling at present.

Manufacturers are sure to take advantage in increasing measure of this entire sales-promotion organization, which is maintained by the government and renders its service free to bona-fide American companies. Any company starting an export business will do well first to pay a visit to the bureau in Washington to find out exactly what assistance it can render.

Industry Need for More Leadership in the Jobbers' Association

THERE is a trend today toward strong leadership in industry association work. It has become the custom not only to elect as president an outstanding leader in the industry, but to appoint, at a high salary, a managing director of the association, selecting a strong executive of recognized capacity and making him responsible for the energetic promotion of the purposes of the association. In the electric industry Aylesworth, and now Clapp, of the National Electric Light Association, Waller of the National Electrical Manufacturers' Association and Davis of the Association of Electragists are fine examples.

It is an ideal combination. For an association president aided only by a "secretary" or a "manager" can rarely do much of a job. His own business naturally has first claim on his time and thought. And so the man most desirable as president can seldom be induced to serve, because he is unwilling either to sacrifice his own company or to neglect the association and leave a record of small accomplishment. Likewise, even a strong managing director is badly handicapped without an outstanding president. For, no matter how good he is, the hired man of the association cannot speak in the councils of the industry with the same challenging voice that a president may use, nor can he call his members to action with the same independence. There is a growing conviction, therefore, that the solution of the besetting problems of distribution in the electrical industry is being materially retarded by lack of effective organization and progressive personal leadership among the jobbers, whose association operates without any president at all.

The Electrical Supply Jobbers' Association is one of the oldest electrical industry organizations. Its summer convention has become a classic, as the meeting place of the manufacturers and wholesalers. Its membership embraces the most successful and experienced jobbers in the business, who today are distributing the greater volume of electrical supplies and appliances. These men have supported their association conscientiously through years of rapid and complex developments. Good times and bad, the executive and commodity committees of the E.S.J.A. have battled with the difficulties that have marked the fast-changing evolution of their line. The industry has seen no finer record of consistent service and loyalty than in the work of these committeemen and of their veteran general secretary, Franklin Overbagh. Changing conditions, however, have crystallized problems which appear to be beyond the scope of the present form of organization, and men of the industry are voicing the opinion that distribution is suffering for want of the kind of enthusiastic personal leadership and energetic executive direction that has been secured for so many other associations by the combination of an outstanding president, ambitious for the achievement of constructive progress during his administration, and a strong, virile managing director, who can get the work done and assure continuity of essential policies.

Obviously, the form of organization and the policies of any association are matters that its own members decide to suit themselves. At the same time, all electrical men are dependent upon the function of distribution. And the fact that there are more jobbers outside the E.S.J.A. than in it is of concern to them because it means that a large number of the distributors—most of them small—are therefore unco-ordinated. Moreover, it is apparent that many of the present ills of distribution in the electrical industry concern the relationships between the jobbers and the manufacturers, between the jobbers and the power companies, between the jobbers and the retailers and installers, and they involve the broad principles of the economics of industry and trade. The interpretation and solution of these problems calls for personal initiative and courage of the highest order. Distribution must be made a conscious issue in the councils of the entire industry. It will be made one when there is among the association presidents a man of personality and leadership who is empowered to speak for distribution. That is the thought that is behind the growing discussion of the present organization of the jobbers.

Saturation and Electric Lighting

MUCH has been and is being said of the saturation point in the automobile field. What of the saturation point in the field of electric lighting? Where is that point and when will it be reached? Not so many centuries ago the standard of illumination was about zero. Undoubtedly our ancestors made a regular practice of going to bed at night—because they had no light to stay up by. But as means of light came into their hands they began to put off the hour of retiring. And gradually their standard of illumination has increased to our present practice in electric lighting.

Why does this standard increase and where will it stop? The human race since its inception has had a standard of illumination in sunlight. Why is not this, then, the standard of night illumination to which the human race is unwittingly attempting to approach, and why should not the lighting company assist in this approach? Here is a field of development for the lighting companies and the interested industries which probably exceeds any branch of the illumination field now being developed. The approach to it seems to be offered in street lighting.

In every community the best-lighted section is that of the main business street. Here we find the brightest illumination and generally the most business. Although the illumination throughout the remainder of the community does not equal that of its business section, still this standard of illumination, if high, tends to raise the standard for the entire community.

If the lighting intensity of the main street or section of a city be increased to a point where the actual illumination is greatly in excess of that ordinarily considered necessary, a new standard is immediately set up which must slowly but surely raise the standard of illumination for the entire locality. Adjoining streets, although previously considered well lighted, must now, owing to their apparent darkness, be more brightly illuminated. Show windows along the street become dimmer to the eyes, and the illumination in these must be increased. Following this must logically come the store itself. This new standard spreads to the adjoining streets and to the stores which line this street. Ultimately it should reflect itself throughout the entire community.

The psychological effect of the new standard should tend to raise the standard of illumination of the entire community, and when the community has arrived at this new standard, then the standard itself could again be raised.

Where Good Relations Originate

DEPARTMENTAL procedures that develop good public relations are usually most efficient from a purely business viewpoint. Instead of considering public relations activities as an abstruse function, greater progress will come from thinking of the functional operations of the company and the public opinion which individual employees develop in their daily work.

A few functions which affect public opinion are the procedure accompanying applications for service, service installations or home wiring, meter reading and testing, collections, complaint handling, fuse replacement, merchandise policies, appliance-repair service, telephone conversations and facility in bringing business to completion. Among industrial customers the foregoing functions may be supplemented by the following: Rate forms, adjustments for power factor and demand, increasing power facilities, advisory service.

Because of the personal as well as business points of contact which employees have with the public, there is need of considering health and life insurance, employee voice in management, attitude of department heads toward subordinates, recognition of suggestions and personal merit, removing causes of internal jealousies, opportunities for employment investment and advice on how to advance in the company's service. Commercial relations will be solved chiefly by the policy of "live and let live."

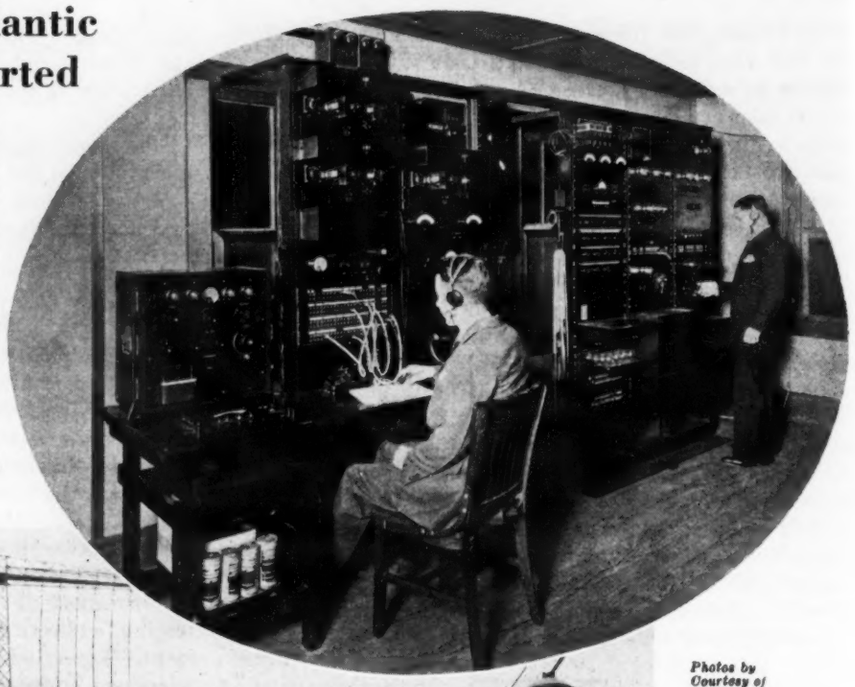
Proper Plug Avoids Blocked Outlets

IN THE older wiring installations with single outlets the householder is subject to considerable inconvenience. Floor lamps, vacuum cleaners, tea samovars and other portable conveniences must be used one at a time and attachment cords removed or inserted as each appliance is used. It has been suggested that a male and female attachment plug should be attached to the cord of low-consumption appliances by the appliance manufacturers. With the cord attached to the center of this plug it would be possible to insert the male part of the device in an outlet and still permit another appliance to be inserted in the female part of the plug when desired. Manufacturers of wiring devices have made an attachment plug of this type which could be improved and changed slightly to conform to the requirements of this kind of service.

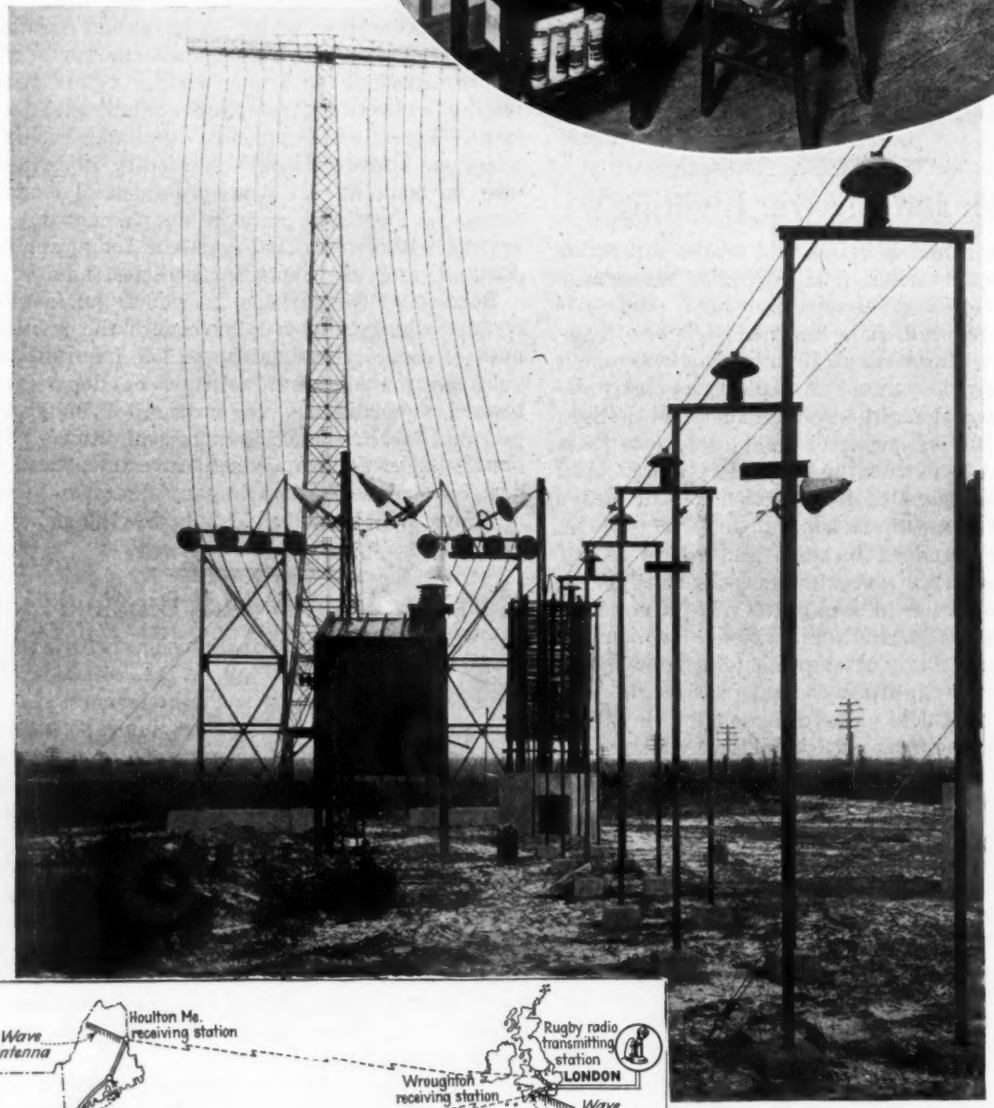
Some means should be found to solve the problem of blocked outlets in homes, for there is little question of the inconvenience of the single outlets and of the loss of revenue which results from the non-use of appliances because of this inconvenience. The suggested attachment plug has demerits as regards mechanical rigidity and overloading of circuits, but these may be more a matter of theory than of practice. It deserves consideration along with other methods that may be suggested.

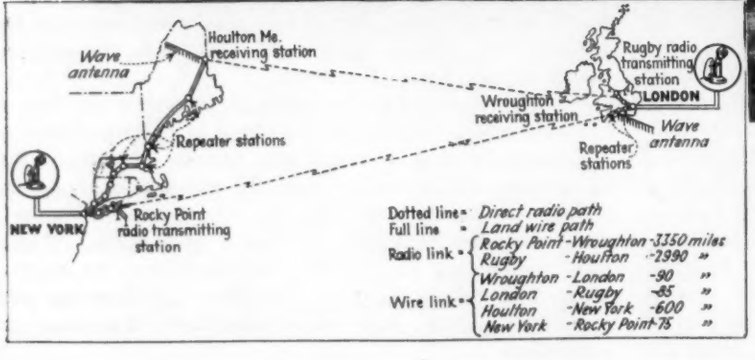
Commercial Transatlantic Radio Telephone Started

ESTABLISHMENT of commercial radio-telephone communication during daylight hours between London, England, and New York City on Friday, Jan. 7, with 31 calls successfully completed the first day, marked an outstanding milestone in communication engineers' subjugation of ether. In this service 6,300 miles of ether path and 850 miles of telephone line were spanned by the human voice. This event was the culmination of long experimentation, research and development, including thermionic vacuum tubes for generation, modulation and amplification, use of a single sideband or suppressed carrier, studies of most desirable wave lengths, developments in directed radio waves and improvements in reception equipment.



Photos by Courtesy of American Telephone & Telegraph Company




Houlton Me. receiving station
Wave antenna
Repeater stations
Rocky Point radio transmitting station
NEW YORK
Rugby radio transmitting station
LONDON
Wroughton receiving station
Wave antenna
Repeater stations
Dotted line = Direct radio path
Full line = Land wire path
Radio link = Rocky Point - Wroughton - 3350 miles
Rugby - Houlton - 2990 "
Wroughton - London - 90 "
Wire link = London - Rugby - 85 "
Houlton - New York - 600 "
New York - Rocky Point - 75 "

RADIO TRANSMISSION eastbound and westbound is conducted on the same wave length (5000 meters or 60 kilocycles), although an alternative (22 meters) is provided to enable the operator to select the best channel when disturbances are maximum.

This service will provide a field laboratory for developing improved methods, including secrecy of conversation.

Improving Electric Conductor Alloys

Requirements of Conductors Discussed—Characteristics of Alloys of Aluminum and Copper—New Alloys of Copper Possess Great Strength and Wear Resistance

By M. G. CORSON
Consulting Engineer, Jackson Heights, N. Y.

METALLIC substances intended for use as conducting parts of any electric circuit must be possessed, in a general way, of the following properties: (1) Suitable conductivity, (2) moderate specific density, (3) sufficient strength, (4) resistance to mechanical wear, (5) resistance to chemical wear (corrosion) and (6) suitable price. No substance so far known possesses in the highest degree all the properties mentioned. There are, however, six metals that may compete under particular conditions. Table I reproduces their most important (from the viewpoint of the electrician) properties as far as they can be expressed in concrete figures.

This table requires some explanation. Gold, for instance, is hardly considered an industrial conductor at the present time; however, conditions may be foreseen where gold wires and even gold cables would represent the safest and eventually the cheapest conductor to be used. The same applies to chromium; scarcely an electrician has seen so far a pure chromium metal wire. There is, however, no doubt at all that chromium will be produced in a ductile form, and its probable strength (the strength figures in the table are purposely too low), coupled with high resistance to dry and wet oxidation and mechanical wear, will make it a favorite conductor metal in many cases. The only doubtful thing about chromium is the high conductivity figure, which, to the author, does not seem to be sufficiently corroborated.

If we agree, however, to leave out of consideration the possibilities of silver, gold and chromium and further to cast aside iron, which might be termed the poor man's conductor, we have left only copper and aluminum. Both have a complex of good properties of a different nature and both suffer from the same two evils—low strength and low wear resistance.

PRINCIPLES OF ALLOYING

The metallurgist possesses a number of means of improving a given metal in strength and wear resistance by alloying. The real problem is to find methods of alloying that do not affect the conductivity to a detrimental degree and that do not call for incommensurate expense.

The oldest and scientifically the most elaborated way of a non-reversible strengthening of a metal consists in forming a solid solution—that is, replacing some of the atoms of the base metal in its crystalline lattice with atoms of an alloying element. The actual mechanism of this strengthening is still a matter of hypothesis, but we know definitely how far copper and aluminum can be strengthened in this way. Unfortunately, we know just as well that in each case an enormous drop in conductivity ensues. The alloyed metal becomes strong but usually stops in its electric characteristics at a point where it can serve neither as an acceptable conductor nor as a fair resistor. In other words, it becomes worthless from the electrician's viewpoint. Table II shows a few features of such solid solution alloys of both copper and aluminum.

Another way of strengthening—by alloying and heat-treating—was in age-long use in the case of steel; it was incidentally applied to alloys of the duralumin type as well. Finally, in recent times it has come into use for copper. This last development became possible after a succession of metallurgists, H. M. Howe, Paul Merica, Zay Jeffries and E. C. Bain in America and finally Hanson in Great Britain, promulgated and brought to a considerable development the theory of hardening by ultramicroscopical (or colloidal) precipitation of a hardening substance within the grains of the main metal. This theory requires that an element or a complex of two elements be considerably more soluble in the base metal at a high temperature than at room temperature. The process entails: (1) Making a suitable alloy, (2) bringing it into a state of perfectly solid solution by heating to a suitable temperature, (3) preserving this solid solution, partly at least, by quenching, (4) precipitating the hardener by low-temperature

TABLE I—PROPERTIES OF METALS USED IN ELECTRICAL CIRCUIT

Metal	Specific Resistivity in Microhms at 20 Deg.	Specific Conductivity at 20 Deg. ($\times 10^4$)	Specific Density	Specific Resistivity per Gram Centimeter Microhms	Tensile Strength Annealed, Pounds per Square Inch	Tensile Strength Cold Rolled, Pounds per Square Inch	Brinell Hardness Annealed
Silver	1.6	62.5	10.5	16.8	20,000	46,000	25
Copper	1.7	58.8	8.94	14.1	32,000	56,000	35
Gold	2.3	43.5	19.3	44.4	17,000	32,000	19
Aluminum	2.9	34.5	2.7	7.8	13,000	35,000	16
Chromium	2.7	37.0	6.8	18.4	50,000*	100,000*	100*
Iron	10.2	9.8	7.9	80.6	45,000	95,000	55

*Approxmate.

TABLE II—PROPERTIES OF A FEW MAXIMUM STRENGTH SOLID SOLUTION ALLOYS IN THE WROUGHT STATE

Alloy	Electric Resistivity in Microhms	Electric Conductivity ($\times 10^4$)	Tensile Strength Annealed	Tensile Strength Cold Rolled	Brinell Hardness Annealed	Remarks
30 per cent Zn brass	7.1	14.0	48,000	105,000	42	.....
12 per cent Sn bronze	17.2	5.6	67,000	130,000	70	.....
8 per cent Al bronze	11.1	9.0	67,000	130,000	65	.....
4 per cent Si bronze	24.0	4.4	67,000	130,000	60	As quenched from 700 deg.
5 per cent Cu. 95 per cent Al	6.0	16.7	33,000	42,000	60	As quenched from 500 deg.
15 per cent Zn 85 per cent Al.	4.5	22.2	31,000	45,000	45	.....
8 per cent Mg 92 per cent Al.	7.7	13	45,000	.....		.....

treatment—in some cases as low as the room temperature (duralumin).

The foregoing entails impoverishment of the solid solution, and inasmuch as we know that the formation of a solid solution means a drop in electrical conductivity, its breakdown ought to be followed by a recuperation of the conductivity to a high degree, if not fully to 100 per cent.

ALLOYS OF ALUMINUM

In the case of aluminum it did not take long to discover the truth of this assumption. By alloying this metal with about 1.2 per cent magnesium and 0.7 per cent silicon a product is obtained that forms an almost perfectly solid solution at 500 to 520 deg., and that will remain solid for a considerable time if quenched in water. On the other hand, nearly all the magnesium and silicon will be precipitated in the form of ultramicroscopical particles of magnesium silicide (Mg_2Si) if treated for twenty hours at 100 deg. Under these conditions the alloy, called Aludur in Europe, will have a resistivity of 3.1 microhms only—a figure not too poor in comparison with aluminum—and a strength of 45,000 lb. per square inch, 250 per cent better than pure annealed aluminum. Cold drawing will bring its strength to 60,000 lb. per square inch, or 75 per cent greater than pure cold-drawn aluminum.

ALLOYS OF COPPER

About five years ago the British metallurgists Read and Greaves discovered that copper may also be hardened by alloying and heat-treating. Their procedure consists in alloying copper with nickel (above 5 per cent) and aluminum (above 4 per cent), subjecting the wrought alloy to a quenching from 900 deg. and drawing at 500 to 700 deg. Strengths of 100,000 lb. per square inch and a hardness of a 175 Brinell were obtained in these alloys. Unfortunately, it takes too much aluminum and nickel before the alloy becomes suitable for heat-hardening. In consequence the hardened alloy represents an ultramicroscopical precipitation of a plain or double aluminide of nickel (plus copper?) within the grains of a solid solution of nickel and aluminum in copper and not in plain copper, as would be desirable. This situation makes a reasonable recovery of the electrical conductivity well nigh impossible. As a matter of fact, the alloys of Read and Greaves do not show much improvement in this direction and remain unsuitable for electrical applications.

This was the situation when the author undertook the solution of the problem of hardening copper without affecting too unfavorably its electrical conductivity. The research was conducted in a systematic investigation, the system of copper-cobalt-silicon being chosen as the starting point. Eventually the systems copper-chromium-silicon on the one hand and copper-nickel-silicon on the other were subjected to the same study. Finally, the copper-iron-silicon system was tapped and the possibilities of replacing silicon by phosphorus, arsenic or beryllium were investigated. The conclusions were reached that Cu-Ni-Si, Cu-Co-Si, Cu-Cr-Si and Cu-Ni-Be systems actually include advantageous ranges of heat-hardenable alloys possessing a high strength coupled with high electrical conductivity upon heat-treatment. The amount of the total addition that will be retained in solid solution is in each case rather small, though perfectly measurable. It does not exceed 0.8 per cent for Ni + Si, 0.3 per cent for Cu + Si, 0.6 per cent for Ni + Be, 0.2 per cent for Cr + Si. In each case it is apparently the compound Ni_2Si, Ni_2Be, Co_2Si or Cr_2Si that forms the hardener. At any rate in the first and the third cases this assumption was proved beyond doubt.

It would take too long to show here the temperature-time conditions of hardening and electrical conductivity recovery with these alloys; the description of a few cases of value for the electrical engineer must suffice.

The high conductivity of pure copper can and frequently is sacrificed by the engineer provided he obtains a material with better strength and wear resistance. A 1.3 per cent tin bronze with 45 per cent electrical conductivity and strength of 75,000 lb. per square inch in the hard-drawn state is only one instance of this kind. It is reasonable to expect that the engineer will welcome the advent of a substitute material of higher conductivity or higher strength, or both. Here, then, are a few figures characteristic of the alloys in the author's group (Corson alloys or Corsonites):

I. An alloy with 2.6 per cent nickel and 0.6 per cent silicon, worked, quenched from 780 deg. C. and drawn at 350 to 520 deg. possesses

87,000 lb. per square inch tensile strength (½ in. diameter)
60,000 lb. per square inch yield point
40,000 lb. per square inch elastic limit
30,000 lb. per square inch endurance
20 per cent elongation in 2 in.
58 per cent standard conductivity
160 Brinell (1,500 kg. per 10-mm. ball)

It can be drawn further to 40 per cent reduction before its elongation drops below 5 per cent in 2 in., and under these conditions it reaches a strength of 120,000 lb. per square inch.

II. An alloy with 4.2 per cent nickel and 1.0 per cent silicon has to be quenched from 840 deg. to retain the state of perfect solution. Drawn under the same conditions it develops:

115,000 lb. per square inch tensile strength
75,000 lb. per square inch yield point
45,000 lb. per square inch elastic limit
36,000 lb. per square inch endurance
17 per cent elongation in 2 in.
45 per cent standard conductivity
196 Brinell hardness

This alloy does not permit further cold drawing beyond the 3 to 5 per cent reduction required to give its surface a smooth finish. Coils of both alloys can be brazed using a 38 per cent Zn, 0.6 per cent Sn, 0.4 per cent Ni, 0.15 per cent Si welding rod preliminary to the heating and quenching operation, but the joint will always represent a weak point with only 70,000 lb. strength as heat-treated and 95,000 lb. as cold drawn to 40 per cent after the second heat-treatment. This strength is by no means lower than in other brazed-joint cables, but the joint will always require an additional reinforcing to develop the full benefit from the strength of the cable itself.

III. An alloy containing 1.8 per cent cobalt and 0.5 per cent silicon has to be quenched from 870 deg. before being hardened at 350 to 550 deg. As heat-treated it shows:

80,000 lb. per square inch tensile strength (½ in. diameter)
55,000 lb. per square inch yield point
40,000 lb. per square inch elastic limit
32,000 lb. per square inch endurance
18 per cent elongation in 2 in.
65 per cent standard conductivity
160 Brinell hardness

It can be cold drawn to 30 per cent reduction as heat-

treated and will then possess 100,000 lb. per square inch tensile strength.

It can be brazed (before the first heat-treatment), using a welding rod containing 25 per cent Zn, 1 per cent Ni, 0.25 per cent Si.

IV. An alloy with 0.5 per cent chromium and 0.15 per cent silicon has to be quenched from 900 to 930 deg. and after a heat-treatment at 300 to 550 deg. it will show:

52,000 lb. per square inch tensile strength
30,000 lb. per square inch yield point
20,000 lb. per square inch elastic limit
35 per cent elongation in 2 in.
81 per cent standard conductivity
95 Brinell hardness

Cold drawn to 50 per cent reduction, it shows 82,000 lb. per square inch tensile strength and 79 per cent standard conductivity. It can be brazed, using a 15 per cent Zn, 1 per cent Ni, 0.25 per cent Si welding rod, and after heat-treatment and cold drawing the joint will have nearly the same strength as the whole wire.

It is believed that alloys I, III and IV will find extensive use for trolley and overhead telephone wires; also that in a large number of instances they will decrease the cost of initial installation required to connect small users of electricity with the main line by cutting down more than 50 per cent of the amount of supports required.

Alloy II can be extensively used for any electrical part where resistance to wear is of great importance (collector rings, commutator sections, contact wheels, springs in switches, etc.).

Electric Melting of Gray Iron Saves $30 Per Ton

Castings Now Produced at the Century Plant with Electric Heat—Service Reliability and Cost Data Significantly in Favor of Electricity

BY J. L. FADEN

MORE than a year ago the Century Electric Company, St. Louis, Mo., established its own gray-iron foundry largely as an experiment, but the result was such as to warrant operating on a production basis. The present output of castings is about 134 tons a month, or 30 per cent of the company's requirements. Castings produced are fully up to the required standard of quality and are being made at a saving of about 25 per cent over their cost if purchased outside. These savings made in a typical month amounted to approximately $3,900.

A careful study was made relative to the proper type of equipment to use, and a Moore 'Lectromelt furnace of one-half-ton rated capacity was selected. This equipment was installed in May, 1925, and has shown marked ability to stand up under continuous operation. The acid process is used with siliceous refractories.

Three shifts are employed in the foundry to give 24-hour operation. The furnace is regularly charged to 150 per cent of its rated capacity and turns out twelve 1,500-lb. heats in 24 hours. The average length of heat is one and one-half hours. Shutdowns for repairs of any kind have been infrequent and never of long duration. The dependence of the entire foundry on the single electric furnace makes continuity of operation essential, and the furnace has met this requirement in a thoroughly satisfactory manner.

TABLE I—COST OF OPERATING HALF-TON ELECTRIC MELTING FURNACE

Annual Fixed Charges:			
Depreciation—(first cost plus installation expense) $19,000 ÷ 10 years			$1,900
* Average interest at 6 per cent: (11 ÷ 10) × $19,000 × (0.06 ÷ 2)			627
Allowance for mechanical repairs			350
Total annual fixed expense			$2,877
Monthly Furnace Operating Costs, June, 1926			Per Ton of Good Castings
Monthly Fixed Expense: $2,877 ÷ 12 months		$239.75	$1.79
Materials charged:			
Pig, 31.2 tons at $26.28	$819.94		
† Cast iron scrap, 93.7 tons total, less 58.281 tons foundry returns, or 35.419 tons at $18	637.54		
Cast-iron borings, 31.2 tons at $9	280.80		
Steel turnings, 26.975 tons at $9	242.78		
Laminated punchings, 24.925 tons at $9	224.33	$2,205.39	16.46
Ferrosilica, 5,917 lb. at $0.0425	251.46		
Ferromanganese, 279 lb. at $0.07	19.53		
Anthracite coal, 112 lb. at $0.00675	0.76		
Carbon, 10,418 lb. at $0.0109	113.56	385.31	2.88
Electrodes, 688 lb. graphite at $0.2125		146.20	1.09
Refractories at $0.2525 per ton of material charged		54.63	0.41
Power:			
Consumption, 125,280 kw.-hr. at $0.00822	$1,029.80		
Demand change, 468 kva. at $1.25	585.00	1,614.80	12.05
Labor on furnace:			
Melter, eight hours at $0.65 $5.20			
Helper, eight hours at $0.50 4.00	9.20		
70 tricks at $9.20		644.00	4.81
Total cost per ton of good castings, including fixed charges		$5,290.08	$39.49

* Allowing for interest earned by depreciation reserve.
† Includes 54.146 tons of gates, sprues, etc., and 4.135 tons of defective castings.

The principal products are end plates and frames for various types of electric motors. These pieces weigh from 3 lb. to 100 lb. each. A typical casting analysis is as follows:

Carbon, 3.25 per cent; manganese, 0.55; phosphorus, 0.55; silicon, 2.75; sulphur, 0.05 per cent.

All castings have comparatively light sections and often involve intricate core work. The quality of the iron, however, is such that the rejections are not serious, usually running less than 3 per cent of the total castings.

OPERATING PROCEDURE

Operating labor on the furnace consists of one melter and a helper on each shift. The loading is done by hand, but the furnace is fully automatic from

TABLE II—MONTHLY SAVINGS EFFECTED OVER PURCHASED CASTINGS BASED ON PRODUCTION IN JUNE, 1926

			Cost per Ton of Good Castings
Cost of purchased castings:			
133.93 tons at $0.0575 per lb.		$15,401.95	$115.00
Operating cost at foundry:			
All furnace items except labor	$4,646.08		
Labor:			
Payroll, total foundry	6,025.20		
Executive prorate	748.35	11,419.63	85.26
Gross savings on monthly production of foundry (Reduced by fixed expenses on buildings, etc.) Approximate saving in June, 25 per cent		3,982.32	$29.74

PRODUCTION AND COSTS FOR THREE MONTHS

	Tons	Cost
June, 1926:		
Metal charged	208	
Castings produced, total	138.07	
Castings produced, good	133.93	$85.26
May, 1926:		
Good castings produced	122.89	86.78
April, 1926:		
Good castings produced	115.35	89.38

the instant the current is turned on, a steady arc being maintained at all times. A simple hand-tripping mechanism is employed that has stood up satisfactorily in service.

OPERATING COST

An analysis of the operating cost of the furnace made available through the courtesy of J. L. Hamilton, chief engineer of the Century company, is given in Table I. Depreciation and average interest at 6 per cent are figured for a life of ten years. An allowance of $350 per year for mechanical repairs is considered to be ample. The total fixed charge is $2,877 a year, or approximately $240 a month.

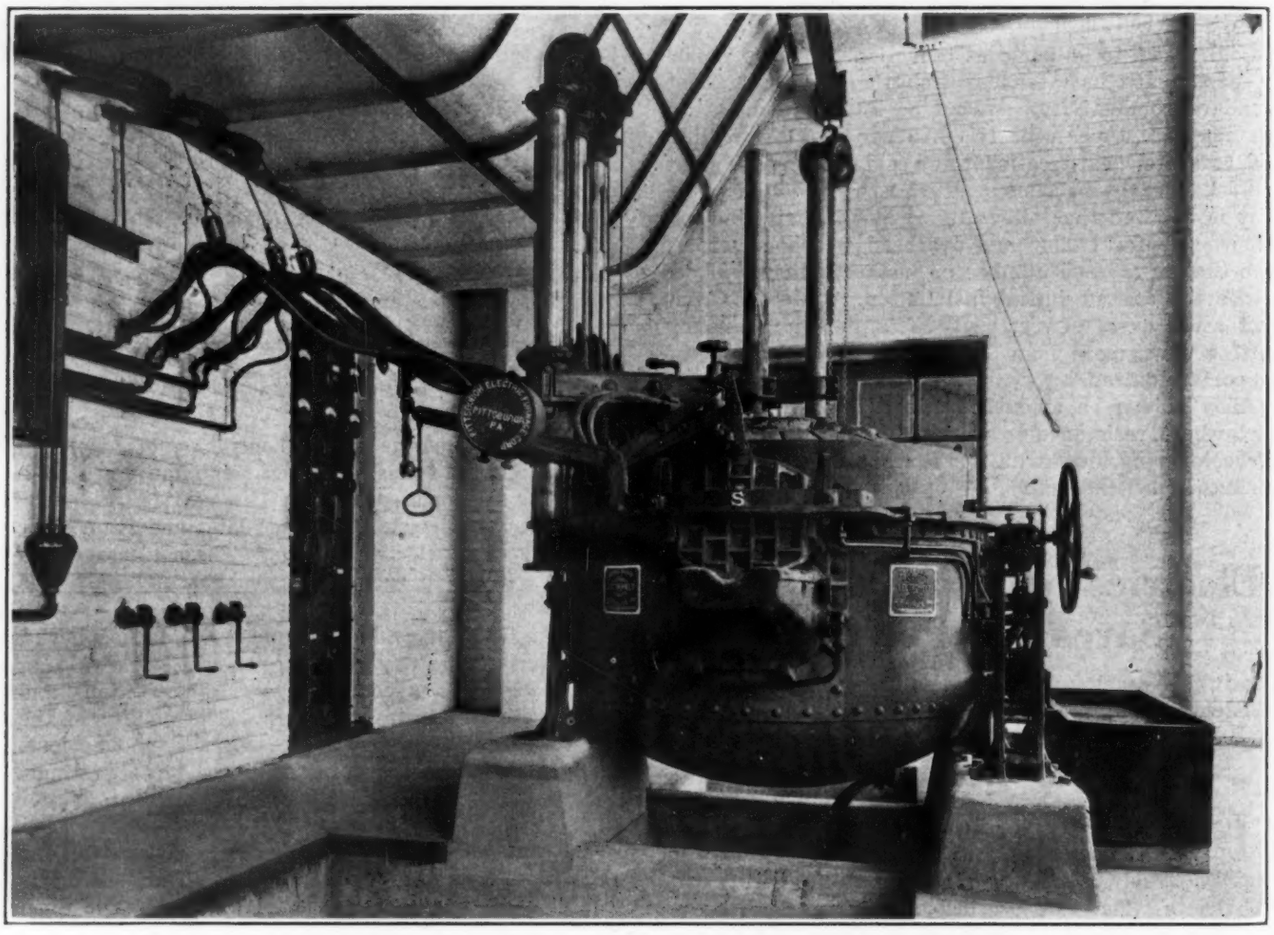
Monthly operating costs are given in detail, including material charged, electrodes, refractories, power and labor. The specific costs used are the actual recorded figures for June, 1926. The total for the month is $5,290, excluding overhead, supervision and fixed expense on the building. With a production of 134 tons of good castings the cost per ton is $39.49.

Table II gives the total foundry operating cost for June and the cost of that month's tonnage of castings if purchased outside. The total foundry labor and the prorate of executive payroll is chargeable to the foundry and is added to the furnace operating cost, making a total monthly cost of $11,419.63. This represents a cost per ton of good castings of $85.26.

With the exception of minor indirect overhead items such as gas, water, light, sand renewal, compressed air and fixed expenses on foundry space, this represents the entire foundry operating cost.

If purchased outside, the June production would have cost $15,402, at the rate of $115 a ton. This exceeds the present cost by $3,982, a gross saving of about 25 per cent, since the indirect overhead items are comparatively small.

The rugged and simple construction of the electric furnace is an important factor in its ability to produce dependably and continuously. Repairs have been few and of small extent. The freedom of the pit from all machinery is an excellent feature of design and the furnace represents the maximum in accessibility both for operation and for maintenance.



THIS FURNACE PRODUCES GRAY-IRON CASTINGS FOR THE CENTURY ELECTRIC COMPANY

FURNACE PERFORMANCE SATISFACTORY

The electrical equipment has given good service. The controls are designed to maintain a uniform heat. Considerable economy in power and operating speed is made possible by the use of double voltage control. The consumption of electrodes in this installation averages only 3.5 lb. per ton of charge, a low record for any electric furnace.

The Century Electric Company considers that the furnace has fully met its requirements and is thoroughly satisfied with its performance. The furnace was supplied by the Pittsburgh Electric Furnace Corporation, Pittsburgh, Pa.

Stability Characteristics of Machines

Low Armature Leakage Reactance and Quick Response in Excitation Desirable for Synchronous Machines Used in Long-Distance High-Power Transmission Systems

By R. D. EVANS and C. F. WAGNER
Engineering Department, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

The stability of operation of alternating-current systems transmitting power for long distances or with large capacity per circuit has received a great deal of attention in the past few years. One of the more important factors entering into this problem is the characteristics of alternators, synchronous motors, condensers and associated excitation systems. As a result of the studies that have been made of stability it is now recognized that certain characteristics of machines are advantageous. Certain new tendencies in the application of these machines are now appearing, the reasons for which are indicated in the accompanying article.—EDITOR.

SYNCHRONOUS machines for use with long-distance transmission lines were until quite recently but little different from machines for short lines. Generators used for supplying power to long-distance transmission systems were chiefly of the hydro-electric type and differed from other machines largely because of the restrictions imposed by the prime movers. In fact, the only real differences appeared as a result of line-charging requirements, which at times had a bearing on the number and size of units employed, and in restrictions as to the minimum number of machines to be kept in service. Line-charging requirements, if affecting machine design, were usually taken care of by stipulation of the machine's capacity to handle charging current without self-excitation. Synchronous condensers were installed at the receiving end of long transmission lines in order to control the receiver voltage and to correct the power factor of the load. The aggregate capacity of these condensers was greater than for short lines, because of larger lagging kilovolt-ampere requirements in order to hold down the voltage at light loads and larger leading kilovolt-ampere requirements to hold up the voltage under heavy loads. Synchronous condensers for use with long lines differed from other condensers principally in the increased lagging kilovolt-ampere range.

In 1923 the problem of obtaining stability—that is, of maintaining synchronism between synchronous machines at supply and receiver ends of long transmission systems—was first given serious study. Since then the problem has rapidly become of greater importance and is now recognized as one deserving most careful consideration in the design of systems not only for long-distance transmission but also for short lines where high kilowatt capacity per circuit is required.

LEAKAGE REACTANCE AND ARMATURE REACTION CONTROL STABILITY

From the standpoint of maintaining synchronism between generators at the supply end and the synchronous machines at the load end of a system, the principal characteristics of machines that require consideration are those of leakage reactance and armature reaction. The initial value of excitation and the speed of response of the excitation system are also important.

Four terms are commonly used to describe the impedance characteristics of machines—namely, armature leakage reactance, transient reactance, synchronous reactance and short-circuit ratio. The first two terms denote ordinary reactances, whereas the latter two describe phenomena involving internal reactions. Armature leakage reactance may be defined as the percentage of normal voltage produced by leakage fluxes set up by full-load armature current, which interlink the armature winding, but do not interlink the field winding. Transient reactance is the value that determines the symmetrical value of armature current at the instant of short circuit. It differs from leakage reactance in that field leakage fluxes are included. Synchronous reactance is a term used for the determination of the regulation of a machine under steady-load conditions. This quantity is not constant but varies considerably with various factors, such as field excitation. When a single value is given as the synchronous reactance of a machine, it is understood to be the ratio of the no-load voltage corresponding to the excitation required to produce full-load armature current on sustained short circuit to normal voltage expressed as a percentage. Because of the variation in synchronous reactance, the term "short-circuit ratio" has come into extensive use as a measure of the relative strength of field to armature. Short-circuit ratio is defined as the ratio of the field ampere-turns required to produce no-load normal voltage to the field ampere-turns required to circulate full-load armature current at zero voltage. The sustained symmetrical three-phase short-circuit current at the excitation corresponding to normal voltage at no load can be determined directly from this ratio. For other values of excitation the short-circuit currents will be in direct proportion.

The problem of maintaining synchronism may be considered for three types of situations as follows:

1. Steady-load condition. Static limit.
2. Switching } Transient limits.
3. Faults }

For steady-load conditions, without voltage regulators, the "synchronous reactance" is, of course, the characteristic of the machines determining the stability limit. In case automatic voltage regulators are employed, the stability limit is greater than that corresponding to synchronous reactance. This is due to the fact that, for small changes in load near the limit, the machines tend to pull out of synchronism very slowly, giving time for excitation systems to increase the field current and thus restore the system to a position of equilibrium. This phenomenon, termed "artificial stability," is quite complicated, and for further information reference may be made to a discussion appearing in a recent A.I.E.E. paper.* The actual limit of a system with voltage regulators will depend upon the speed of response of the excitation system. Stability calculations may be made by using the "internal voltage" of these machines and the leakage reactance. Internal voltage is equal to the vector sum of terminal voltage and leakage reactance.

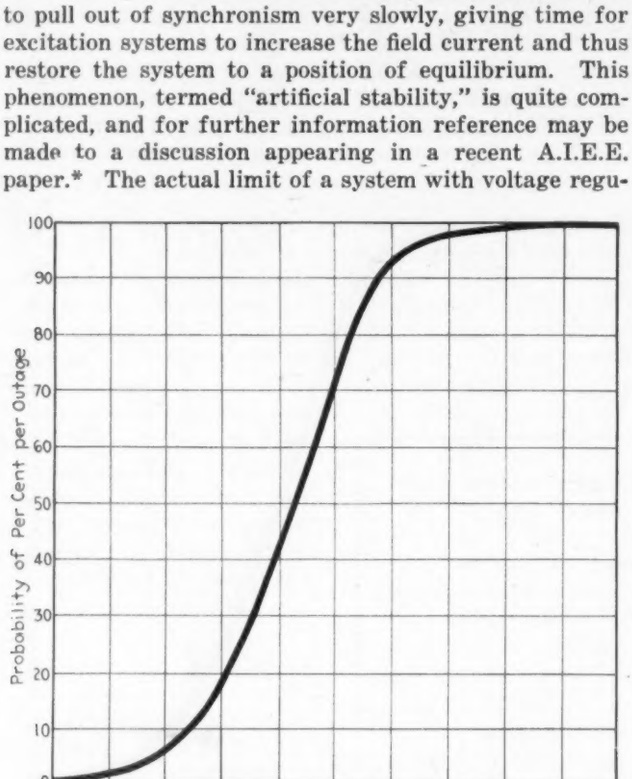


FIG. 1—PROBABILITY OF OUTAGE CURVE OF A TRANSMISSION SYSTEM EXPRESSED AS A FUNCTION OF THE LOAD

Some tests were made to show the effect on the static stability limits of a power system when using excitation systems equipped with automatic voltage regulators with the following results:

1. With fixed excitation, maximum power 100 per cent (used as base). Test value.

2. With an automatic voltage regulator, maximum power 120 per cent. Test value.

The calculation of power limits by leakage and synchronous reactance method gives the following results:

3. Synchronous reactance method with fixed excitation, maximum power 100 per cent.

4. Leakage reactance method with automatic voltage regulator, maximum power 150 per cent.

It should be pointed out that higher power limits would be secured with a faster-response excitation system and that limits are determined not by synchronous reactance but by a lower value.

For switching operations, due to the relatively small amount of demagnetizing effect, the internal voltages do not vary to an important extent during the transient. Consequently the effect corresponds closely to that of using leakage reactance. Under short-circuit conditions the situation is much the same as for switching operations, except that the armature current increases more rapidly and the demagnetizing tendency is much greater, with the result that the apparent reactance of the machine is greater than the armature-leakage reactance because of changes in air-gap flux. After the initial part of the transient the variations in flux are determined, in part, by the system oscillation, which varies the load on the machines, and, in part, by the response of the excitation system, which, if sufficiently rapid, will offset the demagnetizing action.

These considerations show that throughout transient disturbances no single value of reactance can be employed and that the result can be obtained only by making separate calculations for the variation in internal voltage. The equivalent value would lie between transient and leakage reactance. Studies made by the writers indicate that a value 15 per cent greater than armature leakage reactance may be a good approximation for switching and faults to ground.

DESIRABLE FEATURES FOR STABLE MACHINES

In the design of a machine there is a certain value of armature leakage and short-circuit ratio that permits the most economical design for a given rating. To decrease the leakage reactance or increase the short-circuit ratio will increase the cost and losses. Changes to reduce the leakage reactance will usually be accompanied by an increase in the short-circuit ratio and vice versa, though a certain amount of independent variation is possible. High short-circuit ratio tends to reduce demagnetizing action in a machine and in this respect is an alternative to quick response in excitation systems. From the stability standpoint a machine of normal design proportions equipped with a quick-response excitation system will be on a par with a more expensive machine with a higher short-circuit ratio but with a normal response exciter. Usually, where stability limitations are important, special machine characteristics will be found desirable, and in these cases the comparison is between two special machines, one equipped with a quick-response excitation system and the other with a higher short-circuit ratio.

ECONOMIC VALUE OF MACHINE REACTANCE

Stability studies have indicated that the maximum permissible load on power systems can be increased by using machines of lower leakage reactance. Since an increased output can be obtained in this way, the question arises whether such a measure would not prove economical, particularly since low-reactance machines, although higher in cost than normal reactance machines, make it possible to use the much more expensive transmission line more effectively. The answer will depend upon the layout for each system. On some of the long-distance transmission lines it has been found that the economic value of machine leakage reactance is about 50 per cent of the normal value and is obtained at a considerable increase in the machine cost. In these calculations all items of expense should, of course, be included, such as increased cost of generators, exciters, regulators and circuit breakers and increased losses in machines and lines. Such calculations are readily made, provided one can set up a sufficiently simple basis for obtaining the maximum permissible load. For accurate answers it is necessary to follow through the stability

*"Studies of Stability," by R. D. Evans and C. F. Wagner, mid-winter convention of A.I.E.E., February, 1926.

calculations for the limiting condition. An approximation, however, that is easy to apply is based on the comparison of the electrical angles between the internal voltages of synchronous machines. Two systems essentially similar in character and having the principal parts of the impedances fixed will have approximately the same margins of stability if the two systems have the same angle between internal voltages of the synchronous machines. The limiting angle for any particular set of conditions may be determined and the calculations for machines of different reactances compared, using this same limiting angle. Small variations in the value of the maximum permissible angle will not have an important effect on the conclusions as to the most economic value of machine reactance.

What Stability Affects

The principal importance of the stability problem is in its bearing on the continuity of service. Theoretical considerations and analysis of data that have been obtained on heavily loaded power systems indicate that the loading of the system has a very important bearing on the likelihood of interruptions. This can be best understood by reference to Fig. 1,* which represents the probability of outage in the supply of power over transmission lines plotted as a function of the load carried. The static limit for normal operation is indicated as 100 per cent. It will be noted that the curve shows a small probability of outage at light loads, such as might occur from operating error or from an unusual operating condition. The curve approaches the static limit as an asymptote with a very high probability of outage for heavy loads on account of overswings. Different systems will have their individual probability of outage curves, which, however, will have this same general shape.

Machines with special characteristics may be selected with two objects in view: either to increase the power output for a given standard of service or to improve the standard of service.

Quick-Response Excitation Systems

Considerable progress has been made in the development of excitation systems having a response characteristic sufficiently fast to permit important changes of the exciter voltage to take place before the critical period of system oscillation following a disturbance has been reached. The speed of the excitation system is determined, in part, by the fact that the critical point is reached in the first swing, with the generator at the maximum angle of lead. Thus, with certain types of disturbances, the maximum swing would occur in approximately one-quarter of the natural period of system oscillation, or in about 0.25 second. Hence with short circuits that are highly reactive, the excitation system must be capable of increasing the exciter voltage appreciably in this small period of time. Another consideration determining the speed of response of the excitation system is that the internal voltage of the machine should not be permitted to drop more than a small percentage below the initial value.

The practical improvements possible with a quick-response excitation system may be understood by reference to the curves of Fig. 2, which are based in part on calculation and in part on test data. It will be noted that with the normal speed of excitation system the drop in voltage for the assumed condition of throwing on reactive load of 100 per cent machine rating is about 15 per cent, whereas with the quick-response excitation system the reduction is only about 2 per cent. The increase in the power limits would be approximately in proportion to these values, but the ability to withstand system swings is much greater than indicated by this comparison.

Quick-response excitation systems involve a voltage regulator and an exciter that should be considered as a unit. Quickness in response is obtained by subdividing the field winding of the exciter. The rotational speed of the main exciter is important, as, in general, it is possible to obtain quicker response from exciters of high revolutions per minute. Sometimes the most satisfactory combination will involve a house generator on the main alternator shaft for supplying power to motor-driven exciter units.

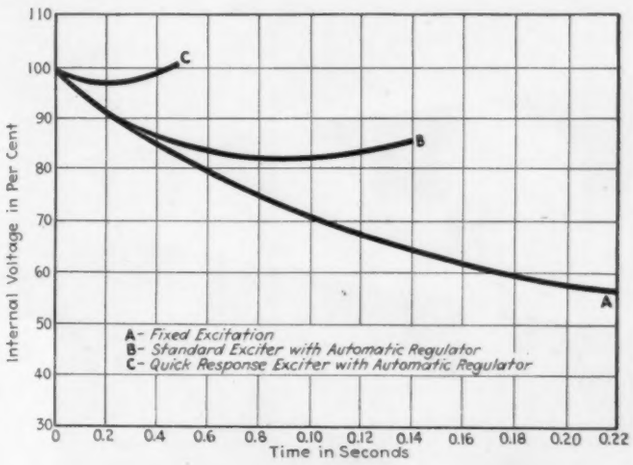


FIG. 2—EFFECT OF QUICK RESPONSE EXCITER IN MAINTAINING INTERNAL VOLTAGE OF ALTERNATOR WHEN ARMATURE CURRENT IS SUDDENLY INCREASED FROM 0 TO 100 PER CENT. LAGGING 90 DEG.

With quick-response excitation systems, it is more important than ever that the operation of regulators should never decrease the excitation when the opposite action is required. With the usual method of operating a voltage regulator from a single potential transformer, it is possible to get false operation, because the voltage on one phase may rise in the event of a fault on another phase. To avoid this trouble, quick-response excitation systems will be operated from the positive sequence component of voltage. This is obtained by the use of two potential transformers and a suitable network that will give the same regulator action, independent of the phase upon which the fault may occur.

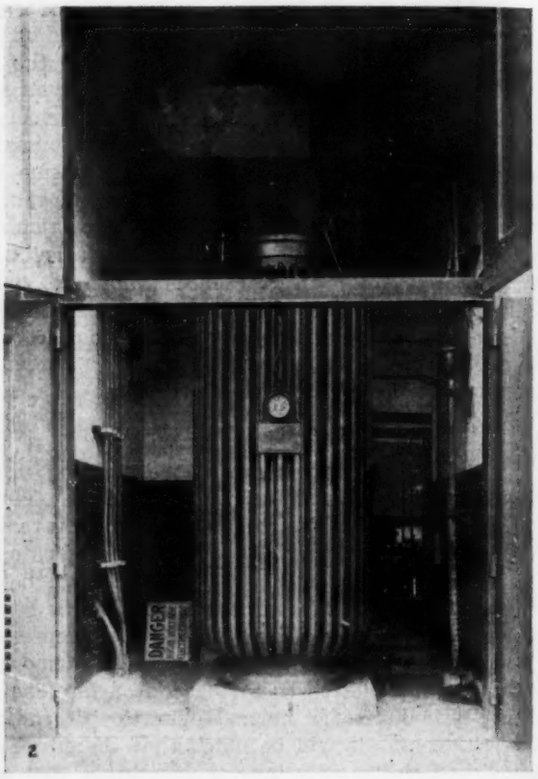
Changes and Trends in Machines

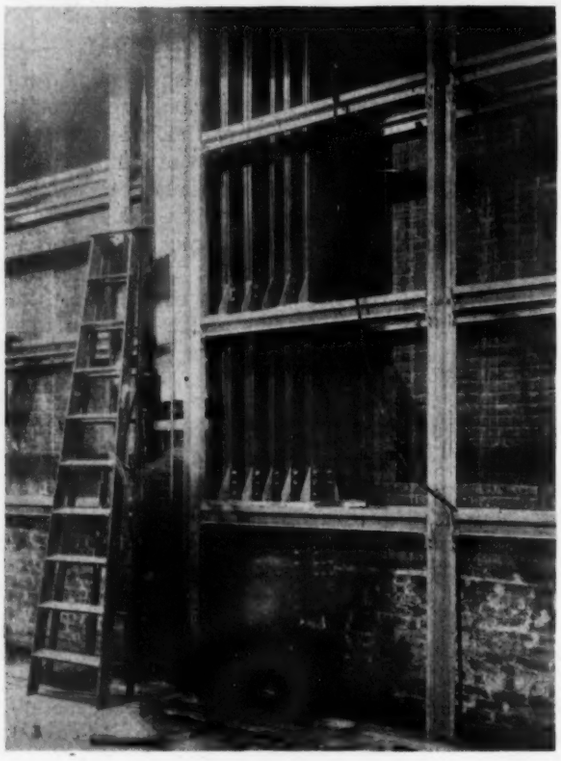
In the more important transmission projects under construction the subject of special characteristics of generators and exciters has received very careful consideration. In two installations the generators will be built with less than normal armature leakage reactance, and in addition one large frequency changer set will possess this same special feature. Quick-response excitation systems have been specified for three installations. This is rapid progress, as the first order for apparatus including either of these special characteristics was placed in May of this year.

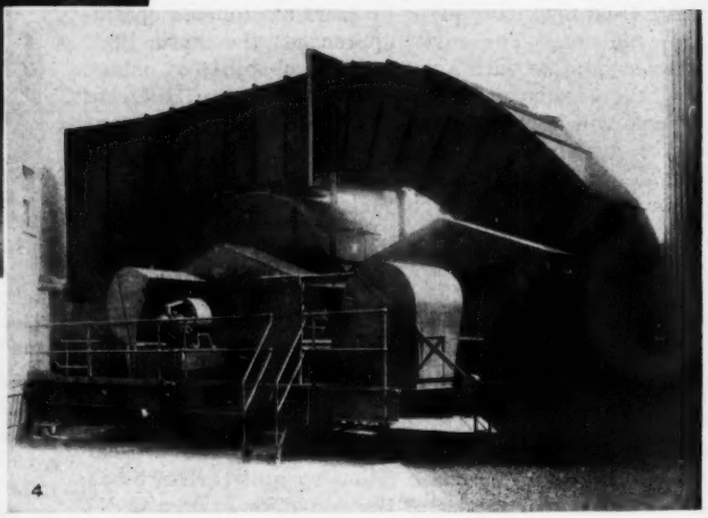
*Refer to discussion by C. A. Powel on "Studies of Transmission Stability," by Evans and Wagner, *A.I.E.E. Journal*, September, 1926.

Construction Features *in* Metropolitan Substations

Substation design and construction features illustrative of the practice of the Edison Electric Illuminating Company of Boston are shown in the accompanying photographs.





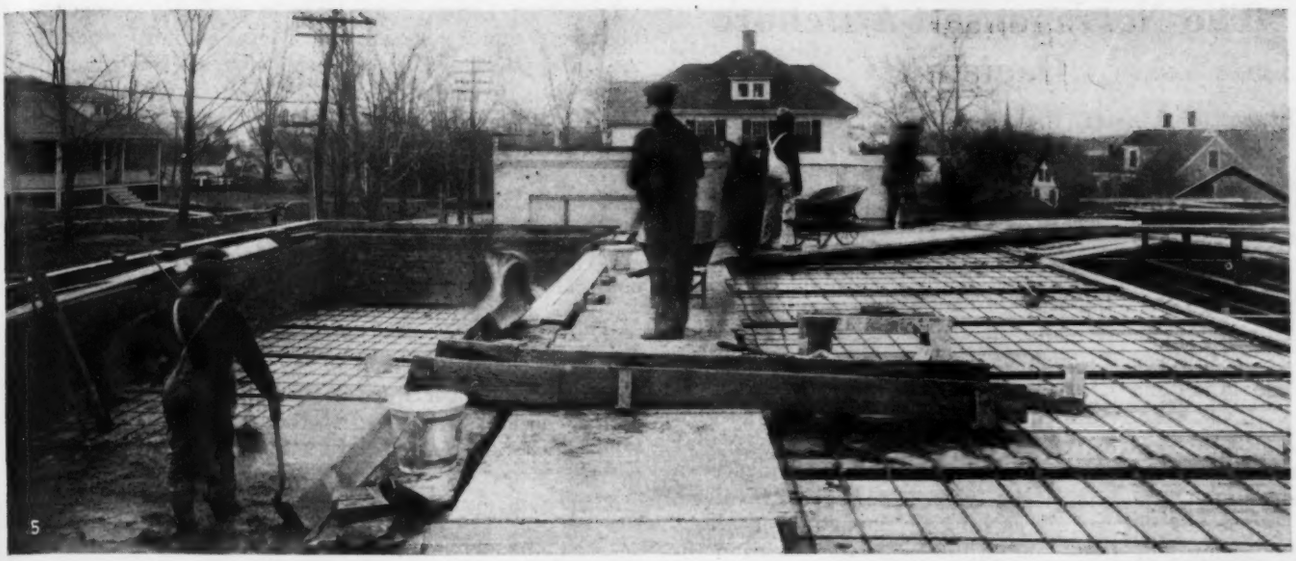


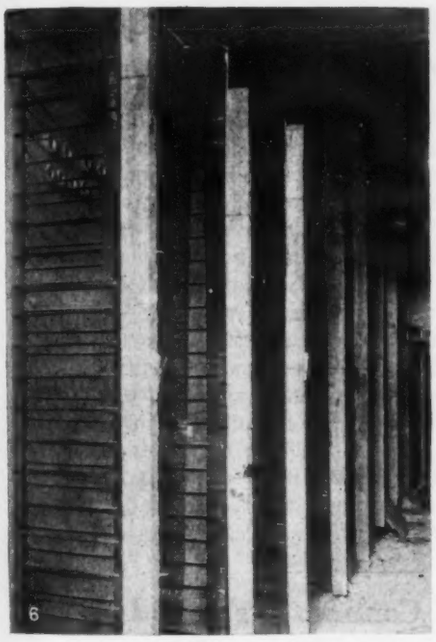
No. 1—Bus compartments and porcelain bushings for bus taps (Dorchester Avenue substation).

No. 2—Individual fireproof transformer cells open onto street (East Boston substation).

No. 3—Vertical runs of heavy copper bus supported by bolted-on shoulders bearing on soapstone blocks carried by horizontal members of steel rack (West Canton Street substation).

No. 4—Ventilating ducts and fans for totally inclosed downtown substation; counterbalanced fan-housing covers and steel platforms facilitate inspection and maintenance.





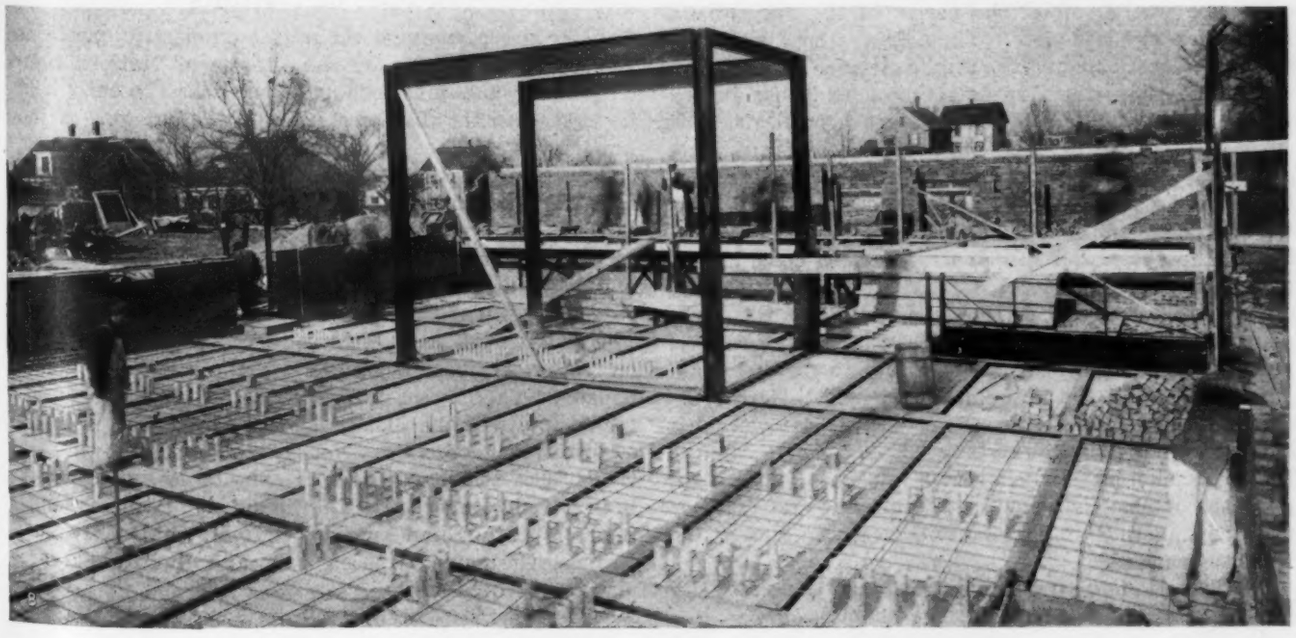
Reinforcing Receives Attention

No. 5 — Pouring concrete roof of Woburn substation.

No. 6 — Reinforcement of concrete barriers for 4,000-2,300-volt cells (Allston substation).

No. 7—Wall reinforcement for high-tension switch-cell room (Dedham substation); horizontal reinforcing rods are staggered to break electrical continuity and fiber conduit risers are used above iron conduit in floor.

No. 8 — Floor reinforcement showing permanent fiber sleeves to permit running conductors through basement rather than through conduits in floor mat, thus enabling it to be made thinner (Woburn substation).



The Narragansett-Attleboro Decision

Interpretation of the Meaning of the Supreme Court's Finding—Result Not Far-Reaching and Should Give Congress No Warrant for Extending Federal Control

By Carl D. Jackson
Counsellor National Electric Light Association

IN REPLY to the Electrical World's request for a brief statement respecting the effect of the decision of the Supreme Court of the United States in the case of Public Utilities Commission of Rhode Island et al. vs. Attleboro Steam & Electric Company, decided Jan. 3, 1927, it may not be amiss to state at once that there is not among some members of the industry a clear understanding of the facts or principles involved. The case is not so far-reaching or important as might be assumed by those unfamiliar with the question involved or the facts in relation to the transmission of electricity across state lines.

The transmission of electricity across state lines is, of course, interstate commerce. This was conceded and was not argued. In many instances the fact that a situation involves interstate commerce does not take away from the state full and effective legal control of the commerce. It may affect control by the state or it may not. Where interstate commerce is involved the power to control such commerce within the limits of the constitution is vested in Congress, but, as a matter of fact, a great mass of interstate commerce has never been subjected to such regulation, and in the absence of Congressional legislation the state may act in many instances with as full and complete power as though interstate commerce were not at all involved. If such control by the state is incidental or local and does not in itself impose an unreasonable burden upon interstate commerce, the state may act. If, however, it does impose a burden upon interstate commerce, the state is powerless to act. The question involved here was under which one of these divisions the Rhode Island case came.

The Supreme Court of the United States had already in several cases decided that, even though interstate commerce was involved, the power of the state to fix local rates was complete. Thus, in the case of Pennsylvania Gas Company vs. Public Service Commission (252 U. S. 23), the Supreme Court held that in the transmission and sale of natural gas—the decision is equally applicable to electricity—produced in one state and transported and furnished directly to consumers in the city of another state by means of pipe lines from the source of supply interstate commerce was involved, but in the absence of any contrary regulation by Congress was subject to local regulation of rates. On the other hand, in the case of Missouri vs. Kansas Gas Company, where there was wholesale transmission of natural gas from one state to a public utility in another state (265 U. S. 298), the Supreme Court held that the contracts for wholesale delivery of natural gas were not subject to change by the state regulatory body. And the recent decision merely held that a wholesale contract for purchase of electricity by a utility in one state from a utility in another state came within the rulings of the Kansas Gas case.

The total amount of kilowatt-hours of electricity transmitted across state lines is probably somewhere between 5 and 6 per cent of the total amount generated. A large part of such transmission is by companies generating in one state and distributing locally in another state, in which case the whole transaction is subject to state regulation. Some part of such transmission is by wholesale contracts from one utility to another, and where this is the case neither the state of transmission nor the state of reception can regulate that contract; but it is quite likely that not more than 2 or 3 per cent of all electricity generated comes within the doctrine of the Rhode Island case.

Furthermore, it is to be remembered that this is the only case that has arisen in the experience of the electrical industry where the question has been important or has materially affected state regulation. It is quite true that transmission across state lines will increase in the future, but it is inconceivable that such transmission will ever attain a magnitude comparable with the amount generated and distributed in the states themselves.

Not Comparable with Railroads

The situation must not be confused for one moment with the situation in respect to railroad transportation. About 80 per cent of all revenues received by the railroads of the United States arise from interstate commerce. Here interstate commerce is the main thing, local state transportation somewhat incidental. In respect to electricity probably 97 or 98 per cent of all revenues are derived from local and state sales. The revenues involved in wholesaling of electricity across state lines between utilities are a mere incident. The question in respect to state regulation in regard to the carriers was whether the states in regulating the incidental part of carriage purely intrastate should in considerable measure regulate the main body of rates. The question here presented is whether the federal government should interfere with state regulation where the interstate commerce revenues are a trifling proportion of the revenues for electricity sold.

Electrical Committee Formed by League of Nations

THE new permanent committee on electric questions set up at Geneva by the League of Nations committee of communications and transit has recently held its first session. The committee is the outcome of the importance attached at the sixth assembly of the league to the study of the problems surrounding the organization and utilization of electrical energy produced from water power. It was then pointed out that a satisfactory international agreement on this subject might have very beneficial effects not only upon the economic reconstruction of Europe, but upon the world in general. The question of the creation of a center of information on electrical matters is among the items upon the agenda. The Assembly of the League, which has already approved the idea of such a center, sees in such a development the extension of the transit organization's activities beyond its present limits, which have been mainly European. The president of this committee is a Lithuanian engineer, M. M. G. Dobkevicius. France, Germany, Greece, Italy and Switzerland are also represented on it.

Problems of Codification and Standardization

A Mechanism for Applying Regulation—Personnel, Functions, Guiding Principles of N.E.L.A. Committee—Problems for Consideration

By Irvin W. Day
Chairman N.E.L.A. Committee on Codes and Standards, Vice-President Connecticut Power & Light Company

THE power industry has long recognized that some codification and standardization are necessary, that some more are desirable, but that it is threatened with getting much more than is needed or wanted. Some power officials have even experienced how surely the printing of codes and standards by some nationally known body was followed by their incorporation into laws, regulations, ordinances or court orders which sometimes did not fit the requirements of the situation and became unduly burdensome in some respects. In any event, these laws, regulations and ordinances frequently receive harsh interpretation and can only be changed with great difficulty after considerable and unfavorable compromise with parties which may or may not have a direct interest in the question at issue but are in a position to make capital of the situation in which the power companies find themselves.

It is only to be expected that regulation-making bodies, which visualize their functions only in an indistinct and general way, should be strongly inclined to look about for some printed document which appears best to fit the case before them and which with little or no correction can be incorporated into the record of their proceedings and put out as a ruling, thus avoiding the expense and delay of hiring suitable experts to work out *de novo* a proper remedy.

When the connection between the formulation of codes and the issuing of regulations became generally apparent, it was also apparent that, since executives could afford to spend time and effort in dealing with the adoption and modification of regulations, they could well afford to concern themselves personally with the formulation and revision of codes and standards. Prior to this time the dealing with codes and standards had been considered a detailed and laborious job requiring technical knowledge. In general the higher officials in the power industry gave such matters a wide berth, leaving the field entirely to the technical men and then, usually, only to those engineers whose vision or sense of duty enabled them to see a need and impelled them to render a service.

The foregoing gives the background of the comparatively recent organization by the N.E.L.A. of the national codes and standards committee. Its membership is as follows:

General George H. Harries, H. M. Byllesby & Company, Chicago, Ill.

A. C. Marshall, vice-president and general manager Detroit Edison Company, Detroit, Mich.

Clyde A. Pratt, manager engineering department, Electric Bond & Share Company, New York, N. Y.

Marshall Sampsell, president Central Illinois Public Service Company, Chicago, Ill.

Frank W. Smith, vice-president and general manager United Electric Light & Power Company, New York, N.Y.

W. G. Vincent, Jr., vice-president and executive engineer Pacific Gas & Electric Company, San Francisco, Cal.

Irvin W. Day, vice-president Connecticut Light & Power Company, Waterbury, Conn. (chairman).

The functions of this committee are set forth in the following resolution adopted by the national executive committee of the N.E.L.A. at its meeting in Chicago, Oct. 8, 1926:

Resolved, That matters relating to codes and standards shall be administered for the National Electric Light Association along the following general lines:

1. The special committee on codes and standards shall be charged with the duty of formulating principles and practices for the industry on codes and standards and of assisting in having such principles and practices put into operation.

2. The appropriate national committees shall be charged with the duty of collecting data and determining therefrom specific solutions of the various problems encountered in the establishment of codes and standards.

3. The headquarters force of the N.E.L.A. shall be charged with the duty of administering, recording and publishing the work of the codes and standards committee and of other committees on this subject, of maintaining contact with the various organizations dealing with codes and standards and of co-ordinating the work of the various individuals and committees of the association engaged upon codes and standards activities.

Be It Further Resolved, That all committees of the association and all individual representatives of the association engaged in activities related to codes and standards are urged to observe the principles and practices announced by the codes and standards committee; and in cases where these do not apply, to consult the committee promptly.

Principles to Guide Activities

The new committee met in New York on Nov. 5, 1926, and adopted the following general principles:

1. Codes and other collections of rules or regulations, when offered for promulgation as standards, may enunciate principles to which assent is given. They should contain a minimum of quantitative requirements. Detailed specifications are highly objectionable.

2. Pure engineering standards, whether for dimensions, quality or performance, are necessarily quantitative, but even those should preferably stress the principles involved and tend to avoid restrictive detail.

Standards and Codes Have Different Significance

ENGINEERING STANDARDS may be called definitions. They define or describe the properties or dimensions or performance of the subjects to which they relate, and thereby establish criteria by which all things of the same kind may be judged. They are in general highly technical or at least have a rigorously technical background. Their influence in industry and commerce is salutary and profound, but their effect is not restrictive. For example, the meter is usefully the unit of length, but a merchant may offer his wares in any fractional or multiple measure of this unit, with entire propriety.

CODES, on the other hand, are laws, and cannot in their nature be anything else. Their authority may vary anywhere from actual statute to a mere local agreement based upon the good faith of the parties to it; they are nevertheless laws regulating conduct in greater or less degree. So far as the field of industrial codification is concerned, it will be observed that the mode of development well understood for civil law applies here also. That is, through custom, general assent, formulation into set terms and, finally, rigid statutory form. Codes are necessarily restrictive, and, quite aside from the objects they seek to obtain, they can have no other purpose than to regulate conduct.

3. Due regard should be had for economy. The burden of representation is heavy in time and money, and in order to keep this within bounds efforts should be made to guide standardizing activities into the smallest number of channels practicable, and otherwise to condense such activities.

The committee also adopted rules for the association governing the method of procedure for the conduct of codification and standardization activities. These rules deal in some detail with the methods to be followed in directing association activities in codification and standardization matters, with the duties of the individuals who represent the association in this field and with the means for publishing to the industry, and procuring industry opinion upon, the current codifying and standardizing activities with which the association is concerned.

There are many problems of a broad nature to receive the consideration of this committee. Some have already come up, others will come before it shortly, and others will arise from time to time. For instance, the electrical apparatus committee of the National Engineering Section at its meeting of Dec. 4, 1925, adopted a resolution, which involved the following ideas:

Codification along electrical lines should be confined to the National Electrical Code or the National Electrical Safety Code.

Any revisions or amplifications in codes that seem desirable to any group should be presented to the American Engineering Standards Committee for revision of either one of these two codes.

The question arises, Should the N.E.L.A. adopt this as its official attitude in the matter? If not, what modifications or qualifications should be added? If the views of the electrical apparatus committee are concurred in, what position is to be adopted with respect to the many other codes, standards, specifications and rules which affect the power industry, such as the boiler code and the power test codes of the A.S.M.E., the standards of the A.I.E.E., the regulations of the National Fire Protection Association and the specifications and standards of the American Society for Testing Materials? All of these products find their way to a greater or less degree into regulations. What attitude shall be adopted toward codifying and standardizing bodies—existing bodies and those which may spring up in the future?

A very important function of the codes and standards committee will be to establish contact with the manufacturers through the newly organized N.E.M.A. or more specifically through their "policy committee—relations with other interests," of which C. L. Collens, president Reliance Electric & Engineering Company, Cleveland, Ohio, is chairman. It is recognized by both parties that most of their interests lie parallel. A joint meeting of these two committees is being planned for Jan. 21.

In conclusion, it may safely be said that a step in the right direction has been taken and widespread benefits will accrue to every one from the efforts now being made to cure trouble at the source rather than at the distant points of outbreak. The national codes and standards committee has made a good start, but it has a big job ahead of it, worthy of its best efforts.

Energy Output for October Exceeds 6,000,000,000 Kw.-Hr.

FOR THE first time in the history of the electric light and power industry in the United States the monthly total of energy generated exceeded 6,000,000,000 kilowatt-hours, the reported total being 6,179,567,000, according to data collected by the United States Geological Survey. This brings the daily average up to 199,400,000 kw.-hr., or only a fraction of a per cent below 200,000,000.

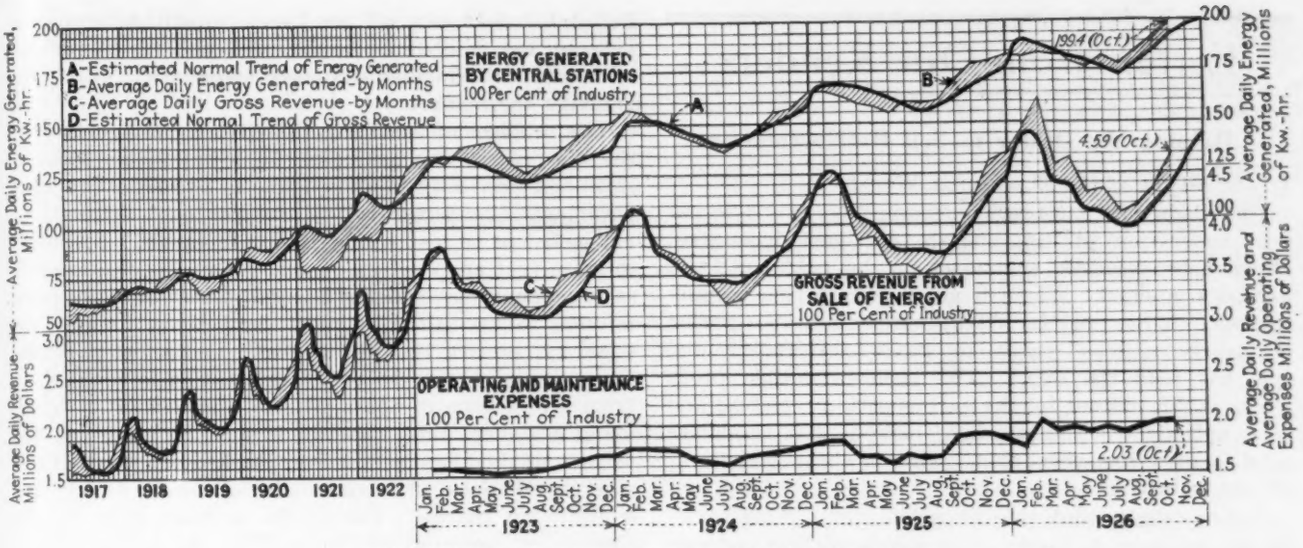
The October revenue was approximately $142,500,000, and the corresponding expenditures for operation amounted to $62,800,000. Comparison of these figures with those for the same month of 1925 shows a gain of 11.2 per cent in the amount of energy generated and a very slightly higher increase in revenue. The revenue was exceeded in accordance with the seasonal trend, during the winter months of last year, at the time when the lighting load, with its relatively high revenue per kilowatt-hour, was at its maximum, but the energy output has never before been equaled.

A regional analysis of the latter shows that the greatest growth occurred in the East South Central States, where the year's increase attained the remarkable value of 22 per cent. Next in order came the West South Central, Pacific and South Atlantic States, where the output was about 15 per cent greater than in October, 1925; then the Middle Atlantic division, close to the national average in its rate of increase, and the New England division, somewhat lower. The great agricul-

TABLE I—GENERATION AND DISTRIBUTION OF CENTRAL-STATION ENERGY IN THE UNITED STATES
(100 per Cent of the Industry)

Month	Kw.-Hr. Generated Monthly *			Estimated Distribution of Energy Generated										Energy Purchased by Public Utilities for Resale, Kw.-Hr.	
				Total Energy Consumption by Central-Station Customers, Kw.-Hr.		Energy Consumed for Lighting, Kw.-Hr.		Energy Consumed for Power, Kw.-Hr.		Energy Sold to Electric Railways, Kw.-Hr.		Energy Used in Intracompany Business, Including Line Losses, Kw.-Hr.			
	1926 Thousands	1925 Thousands	Per Cent Inc.	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands
July.....	5,562,172	4,966,266	+12.0	4,489,172	4,009,266	1,164,000	1,079,000	2,761,172	2,384,266	564,000	546,000	1,073,000	957,000	1,010,000	730,000
August...	5,777,753	5,085,379	+13.5	4,662,753	4,102,379	1,212,000	1,123,000	2,886,753	2,433,379	564,000	546,000	1,115,000	983,000	1,103,000	753,000
September	5,821,906	5,125,410	+13.6	4,697,906	4,136,410	1,188,000	1,102,000	2,963,906	2,506,410	546,000	528,000	1,124,000	989,000	1,195,000	797,000
October...	6,179,567	5,550,289	+11.2	4,986,567	4,478,289	1,262,000	1,168,000	3,154,567	2,760,289	570,000	550,000	1,194,000	1,072,000	1,250,000	889,000

*Data on "energy generated" are those collected and published by the United States Geological Survey for all public utilities minus such data as are collected on energy generated by electric railway companies, reclamation service and manufacturing plants. The data are, therefore, for the electric light and power industry only


A-Estimated Normal Trend of Energy Generated
B-Average Daily Energy Generated-by Months
C-Average Daily Gross Revenue-by Months
D-Estimated Normal Trend of Gross Revenue
ENERGY GENERATED BY CENTRAL STATIONS
100 Per Cent of Industry
GROSS REVENUE FROM SALE OF ENERGY
100 Per Cent of Industry
OPERATING AND MAINTENANCE EXPENSES
100 Per Cent of Industry
1994 (Oct.)
4.59 (Oct.)
2.03 (Oct.)
Average Daily Energy Generated, Millions of Kw.-hr.
Average Daily Revenue, Millions of Dollars
Average Daily Revenue and Average Daily Operating Expenses Millions of Dollars
1917 1918 1919 1920 1921 1922
1923 1924 1925 1926

DAILY ENERGY OUTPUT APPROACHES 200,000,000 KW.-HR.

tural West North Central division reported but a slight increase. The comparison is significant as an indication of the regional trends in industrial activity.

More than half the increase in energy output came from hydro plants, which delivered almost 20 per cent more than they did a year ago, and happen to have generated almost exactly a third of the total. Correspondingly less had to come from fuels, the increase from that source being but 7.3 per cent.

In commenting on September operations in the ELECTRICAL WORLD of Dec. 11 attention was called to the smallness of the change in fuel consumption associated with the very considerable increase in kilowatt-hour output. That achievement has been repeated. The 7.3 per cent additional energy from fuel, amounting in round numbers to 300,000,000 kw.-hr., called for only 0.2 per cent additional coal; with the 8.6 per cent additional fuel oil and 7.9 per cent added gas consumption the thermal equivalent is still less than 1 per cent greater than it was in October, 1925.

Examination of individual company reports from which these statistics are summarized revealed several features that deserve mention. Thus, the average operating ratios of companies generating energy exclusively or in large part from water power is distinctly lower than it was a year ago. This is due to the fact that several large companies reported higher revenues and lower operating expenses, which were not offset by occasional deviations in the opposite direction. On the other hand, it would seem that the pure hydro companies, especially those with a low operating ratio, are more and more being absorbed into mixed systems, for engineering and economic reasons.

TABLE II—OPERATING RATIO OF CENTRAL-STATION COMPANIES

Month	Operating Ratio					
	Steam Plants		Hydro Plants		Combined Hydro and Steam Plants	
	1926	1925	1926	1925	1926	1925
July	51.6	53.6	34.1	32.5	44.9	45.8
August	51.8	51.1	38.7	36.0	44.8	45.3
September	49.3	50.0	37.4	35.0	43.3	46.0
October	47.7	48.6	30.4	34.2	44.0	44.3

TABLE III—CENTRAL-STATION FINANCIAL OPERATIONS FOR FOUR MONTHS IN THE UNITED STATES
(100 per Cent of the Industry)

Month	Total Gross Revenue from Sale of Energy†			Estimated Distribution of Gross Revenue								Total Operating and Maintenance Expenses‡	
				Lighting Customers		Power Customers		Electric Railways		Other Public Utilities			
	1926 Thousands	1925 Thousands	Per Cent Inc.	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands	1926 Thousands	1925 Thousands
July	$127,200	$112,300	+13.3	$81,100	$73,700	$33,400	$28,400	$4,500	$4,300	$8,200	$5,900	$59,300	$54,250
August	127,800	113,500	+12.6	81,300	75,200	33,600	28,300	4,300	4,200	8,600	5,800	59,400	53,200
September	133,000	117,000	+13.6	83,000	76,600	35,900	29,840	4,450	4,220	9,650	6,340	60,400	54,350
October	142,500	127,300	+11.9	89,100	82,000	38,600	33,600	4,600	4,400	10,200	7,300	62,800	56,600

†Aggregate gross revenue from actual consumers, and sales to other public utilities for resale, involving a certain amount of duplication.
‡Do not include interest, taxes, depreciation or sinking fund.

TABLE IV—OPERATIONS OF CENTRAL-STATION HYDRO AND FUEL PLANTS IN THE UNITED STATES*
(100 per Cent of the Industry)

Month	Energy Generated						Fuel Consumption								
	Hydro-Plants			Fuel Power Plants			Coal			Oil			Gas		
	1926 Thousands of Kw.-Hr.	1925 Thousands of Kw.-Hr.	Per Cent Increase	1926 Thousands of Kw.-Hr.	1925 Thousands of Kw.-Hr.	Per Cent Increase	1926 Short Tons	1925 Short Tons	Per Cent Increase	1926 Barrels	1925 Barrels	Per Cent Increase	1926 Thousands of Cubic Feet	1925 Thousands of Cubic Feet	Per Cent Increase
July	1,971,199	1,835,021	+ 7.4	3,590,973	3,131,245	+14.6	2,993,969	2,771,100	+ 8.0	671,984	814,718	—17.5	5,056,094	4,180,741	+20.9
August	2,062,629	1,735,369	+18.8	3,715,124	3,350,010	+10.9	3,060,647	2,975,728	+ 2.9	728,864	720,310	+ 1.2	5,403,316	4,801,130	+12.5
September	2,030,895	1,579,591	+28.6	3,791,011	3,545,819	+ 6.9	3,111,689	3,081,516	+ .9	882,987	769,918	+14.7	4,817,047	5,091,882	— 5.4
October	2,122,260	1,769,058	+19.9	4,057,307	3,781,231	+ 7.3	3,301,259	3,295,768	+ .2	880,924	811,475	+ 8.6	4,859,612	4,503,408	+ 7.9

*As collected by United States Geological Survey. The data are for the electric light and power industry only.

Letters from Our Readers

Helping the Dealer to Sell Refrigerators

To the Editor of the ELECTRICAL WORLD:

One reads with interest the figures that only 1.78 per cent saturation of the electric refrigerator market afforded by domestic customers of the public utilities has been reached. Would it not be interesting to publish what it has cost in dollars and cents over a period of nearly sixteen years to reach this point and who has paid the bills? The largest possible profit which is figured out by the enthusiastic promoters and sales optimists is the bunch of carrots that is always used to urge the worker on. This is characteristic of all new industries.

Let us calmly think this situation over. What parallel can we draw to guide us in merchandising methods and policies? None. The nearest is the automobile industry, but it is possible to sell a luxury three or four times over as compared with a necessity which is to be used in the home. What has made it possible, frankly, to sell the number of electric refrigerators that have been sold to-day? Only the negligence of the artificial ice manufacturer, who has been content to live in a fools' paradise, thinking he had a monopoly and that it was not necessary for him to render direct service to the customers of his product, leaving this in the majority of cases to disinterested peddlers. As a consequence, if the question is put to the average housewife, "Whom do you dislike most to do business with?" she will reply, "The local public utility and the iceman." This condition offered a splendid opportunity for the high-pressure advertising house to exploit and one which it did not fail to grasp.

The merchandising of electric refrigerators requires a high type of intelligence and effort. The ready market is the speculative builder of homes and apartments and the home purchaser. The old-home dweller when approached is always interested, but, owing to the price of the product, is unable, in the case of the housewife, to place an order without consulting the husband. This necessitates further sales effort to convince the husband, who will often undo all previous constructive sales work. Results show that the return for the effort necessary to close such sales is seldom profitable. The door-to-door method of selling cannot be used except in very limited districts because the home owners in a position to purchase an electric refrigerator resent this form of approach. Display rooms on the main streets are without doubt the greatest help to a dealer or distributor, because the prospective customer who calls at the showroom has already been educated and is 90 per cent "sold." The keeping of front-line salesmen is even more difficult than in other industries, because it is at least two to three months before even a high-type man can really feel satisfied that he is obtaining a return for his efforts.

A survey of the turnover in distributors and dealers during the last two years will reveal some surprising figures, as also would the turnover in personnel of the electric refrigerator companies, and this condition is going to exist for two or three years more. There is no doubt that the electric refrigerator industry is established, but next year will see keen competition in selling between the front-line companies themselves as well as with the smaller manufacturers who are continually entering the market.

The problem of servicing the electric refrigerator is the big "if" in this business. It is impossible to have sales and service in the one office, as two different temperaments are necessary. Forty per cent discount is not sufficient to lead a distributor to invest his capital in store rent and equipment, maintain a service organization, pay either drawing account, salary or large commission to his salesmen, meet competitive bidding on quantity, service the refrigerators and show a profit. The revenue to the central power station is reputed as from a minimum of $45 a year to a maximum of $120, using a 10-cent rate, one which must be employed because a method has not yet been worked out successfully whereby the local utilities will install power meters for a minimum charge. Taking the average price of the electric refrigerator sold to be $350, the merchandiser, if he nets 10 per cent, would show a profit of $35. This is all the return he can expect to receive, yet the power company, which has not contributed toward this sale, is to receive continually a revenue of $45 per annum, or in the event of a power meter being installed $22.50 per annum.

May I again offer the suggestion that the public utilities service the electric refrigerator which has successfully passed their test and let this be their method of helping the merchandiser? Service is the foundation upon which the public utilities are established. Are they not suited better than any one else to render this efficiently?

T. E. WILSON.

Pelham, N. Y.

Engineers' and Bankers' Objectives the Same

To the Editor of the ELECTRICAL WORLD:

The article by Arnold Pfau in the ELECTRICAL WORLD of Nov. 20, 1926, contains some interesting details of problems of hydro-electric development intending to show that the plant of highest efficiency is not necessarily the best investment. This is no new principle, however, nor would it seem logical to differentiate between so-called "banker" and "engineer" efficiency. Certainly, the practical engineer in this field is not idealistic, as intimated, to such an extent that his goal is development from the point of view of the "highest possible efficiency of the available natural resource," rather than of the best return to the investor.

The true underlying principles governing the layout and design of hydro-electric developments are economy (or best return from the investment) and safety (or no curtailment in cost which may endanger the continual and safe operation of the plant). Hence it is usually the accepted duty of the engineer to consider different designs and to choose the best from the point of view of estimated return. The broad principle of "minimum annual cost"—i.e., of development cost plus value of power lost—can be kept in mind to good advantage in respect to many of the plant features—and particularly equipment layouts of different efficiency—where conditions are defined closely enough to permit studies of this kind.

In some cases, as shown by Mr. Pfau, equipment with less than the highest attainable efficiency may be proper. On the other hand, conditions may warrant expenditure

to obtain the highest possible plant efficiency, where the market for power is good and the sale price adequate. The end sought by both engineer and banker is therefore the same and may be called "economic efficiency."

H. K. BARROWS,
Consulting Engineer.
Boston.

Theories of Depreciation and Some Recent Decisions

To the Editor of the ELECTRICAL WORLD:

In your issue of Nov. 20 appears an editorial entitled "Depreciation Studies Are Important." No one, of course, will disagree with this heading, nor with its recommendation that accounting for depreciation should be based upon an adequate study of facts. There is, however, or so it seems to me, an implication in the article that the only depreciation charges worthy of consideration are those which purport to be based upon elaborate "life tables." Such tables are frequently introduced into rate cases—almost always against the electrical company—and sometimes a misleading appearance of mathematical exactness is given to them by working out results to the third and fourth decimal place. As a matter of fact, experienced operators know that, at least in the present stage of the industry, life tables are of little or no value. As your editorial indicates, obsolescence and inadequacy are of prime importance, but, as your editorial does not say, obsolescence and inadequacy are not susceptible of reduction to precise mathematical formulas having all the inevitability of a life insurance experience table.

Perhaps the inference which I drew from the editorial that the writer was favorably disposed toward life-table depreciation methods was not altogether warranted by its language, though I fear that others besides myself will draw the same inference. I do feel, however, very strongly that the electrical industry should be arming itself at the present time for a battle with the theoretical depreciationists, and that any suggestion of support for their point of view in the editorial opinion of the industry's leading publication is to be deplored.

Within a few days two events have occurred the importance of which, for the electric light and power companies and for public utilities generally, has not, I believe, been as yet fully realized. The first is the sweeping and tremendously far-reaching opinion and order of the Interstate Commerce Commission requiring all railroads to recognize theoretical accrued depreciation, which has to be estimated on the straight-line, life-expectancy basis and has to be set up on the books of account not only currently but also as an adjustment of such books to record the theoretical loss in "value" due to expired life prior to the effective date of the order. That this opinion will greatly strengthen the attacks by opponents of the accrued-depreciation theory on the methods of financing, accounting and rate making that have been followed by the great majority of successful public utility operators there can be no question. It is not too much to say that if some of the "depreciators" could have their way the result would be a revolutionary reduction of values throughout the public utility field. Whatever may be said for straight-line depreciation accounting on the basis of expectancy of life—and there is something to be said for it, though I do not purpose to do so here—it is a fact that the application of the theory to the accounts of a company which has been financed and managed in accordance with a different policy of caring for maintenance and retirements will cause a startling change in its balance sheet and earnings statements.

As against the Interstate Commerce Commission's order above mentioned, there has come out recently an opinion of the United States Supreme Court (Indianapolis Water Company case, decided Nov. 22, 1926) which, as I construe it, is a rejection of straight-line depreciation as a measure of loss in value. The court holds that "the testimony of competent valuation engineers who examined the property and made estimates in respect of its condition is to be preferred to mere calculations based on averages and assumed probabilities." The opinion as a whole, by the way, is a leading case which will be of the greatest importance in public utility regulation.

Practical experience has demonstrated to the satisfaction of the great majority of operating and financial managers of electric light and power properties that there is no necessity, whether from the point of view of the investor, who requires that the integrity of his property investment be maintained, or from that of the consumer, who is mainly interested in efficient and adequate service, for creating out of earnings and maintaining constantly so large a depreciation reserve as is the inevitable result of a strict application of the straight-line theory. The annual amount necessary to provide a reserve which shall always be adequate to meet normal retirement losses can be fixed within comparatively narrow limits in terms of percentage of fixed capital or of gross earnings by studies of actual retirement losses without reference to theoretical expectancy of life. The Detroit Edison Company is almost the only electric light and power organization of size and reputation that attempts to estimate depreciation charges on the life-table basis.

The other companies have found by experience that an annual allowance determined by past performance will give adequate protection to the investor at a minimum of cost to the consumer. The telephone companies take a different point of view, but conditions in the telephone industry and in the electric light and power industry are different. Even so, most of the electric light and power managers feel that the telephone companies are proceeding on a theory wrong because at best it imposes a burden on present consumers, while at its worst it operates to confiscate property values on which investments have been made in good faith. The Interstate Commerce Commission's opinion and order has shown that the opposition between the two points of view is fundamental. The sentiment among public utility operators for what Mr. Eastman's able opinion calls "retirement accounting" as opposed to "depreciation accounting" is pretty nearly unanimous. While it is undoubtedly true that there is a need for more facts and less guessing about depreciation, the immediately pressing need is for the public utility owners and operators to stand together on the facts already available against a theory of depreciation accounting that may easily, if not successfully opposed, necessitate a complete new outlook toward financing and rate making.

H. C. HOPSON,
Associated Gas & Electric Company.
New York.

Central Station and Industrial Practice

Loading of Distribution Transformers

IT WOULD be uneconomical to load a transformer to the point where the power losses become so large that the total charges against the transformer are considerably greater than the total charges would be against a larger size transformer carrying the same load. Distribution transformers are designed to give low power losses because they are lightly loaded for so great a part of the time. Copper losses are correspondingly higher, but when the peak load is for only a few hours, as in residence service, it is usually considered economical to let the peak load go well above the rated load. For nearly all ordinary conditions it will be found that the limits of temperature will be reached before economic considerations become important.

The accompanying curve, reproduced from a recently released serial report of the overhead systems committee, N.E.L.A., gives an indication of the economics of transformer loading for a particular line of transformers carrying residence lighting loads. Attention is particularly directed to Fig. 3, which shows the transformation cost per kilovolt-ampere for various sizes of transformers at various percentages of rated capacity. Fig. 4 gives the same values, but plotted in kilovolt-amperes of load instead of percentage of rated capacity, and shows perhaps more clearly the most economical transformer for any load.

For the assumed loads and energy cost it can be seen that it is generally economical to load lighting transformers to about 200 per cent of their rated capacity. The variation in the cost of energy will, of course, affect the shape of these curves in a measure. It is suggested by the committee that the values used in this report are probably rather high for large systems.

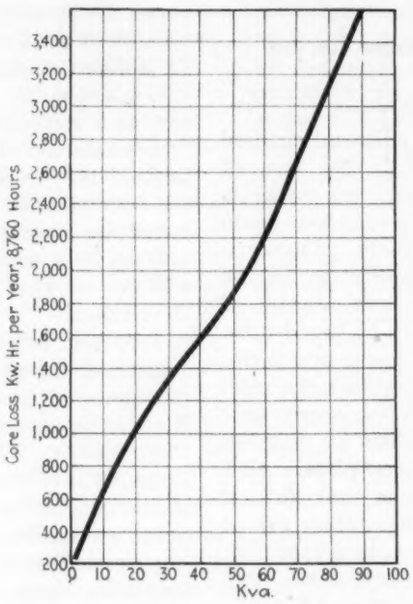


FIG. 1—APPROXIMATE CORE LOSS PER YEAR FOR VARIOUS SIZES OF TRANSFORMERS

Manual Feature Added to Automatic Boiler Control

BY JAMES MURPHY

AN AUTOMATIC system employing steam pressure to control the furnace air supply, coal feed and damper opening has been found very effective in maintaining high boiler room economy without constant attention, but conditions some-

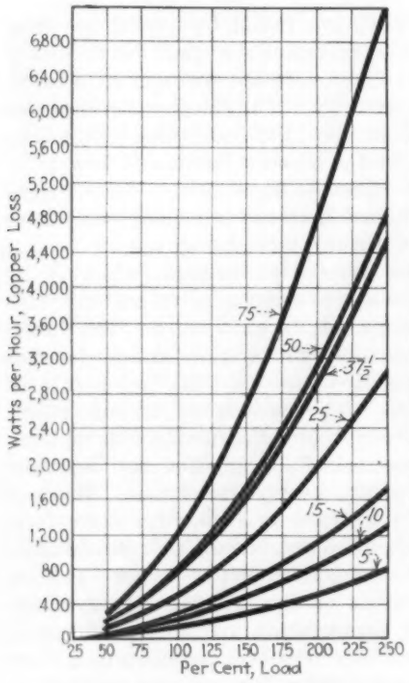


FIG. 2—COPPER LOSS PER HOUR FOR VARIOUS LOADS AND SIZES OF TRANSFORMERS OPERATING AT DIFFERENT PERCENTAGES

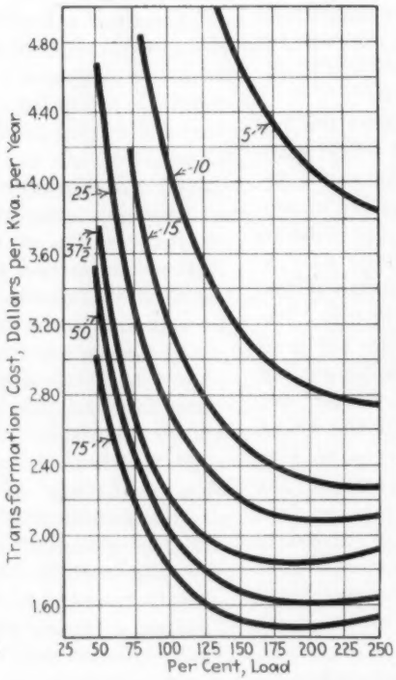


FIG. 3—TRANSFORMATION COST PER KILOVOLT-AMPERE PER YEAR FOR TRANSFORMERS OPERATING AT VARIOUS YEARLY PEAK LOADS

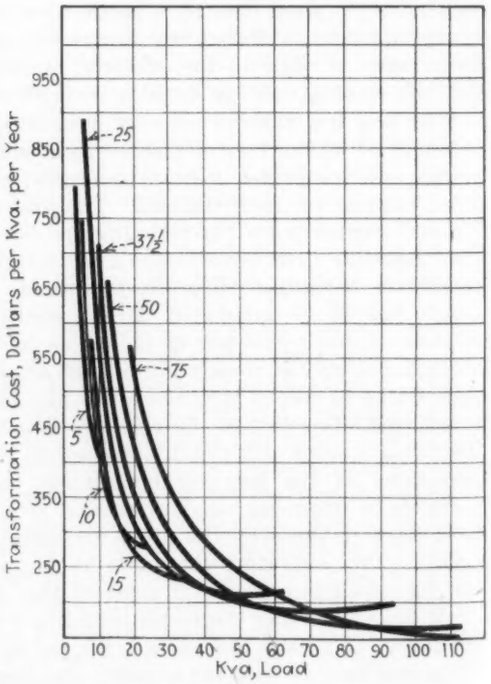


FIG. 4—TRANSFORMATION COST PER KILOVOLT-AMPERE PER YEAR FOR VARIOUS LOADS AND SIZES OF TRANSFORMERS

times arise when the oil pressure in the actuating system may drop sufficiently to shut down the stoker controlled. If such an emergency arises it is desirable to be able to place the units on hand control immediately. In the station where the writer is engaged the automatic control has been adapted to quick manual control by a very simple means.

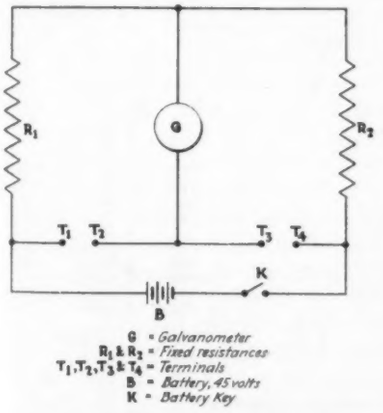
In brief, the control system employed is one that applies the main steam pressure to a diaphragm, which indirectly adjusts the throttle of the blower turbine, the boiler damper and the coal feed. The medium directly actuating the control arm is oil under pressure.

By fastening to a column next to the control arm a quadrant containing $\frac{1}{4}$-in. holes $\frac{3}{4}$ in. center to center so a pin through the control arm will hold it in any desired position, the damper, air and coal feed can still be maintained in the proper relation for any load by manual control.

Resistance Check on Meter Potential Coils

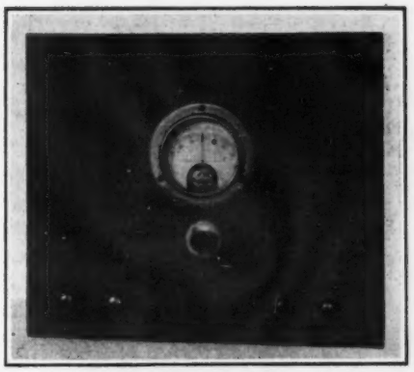
BY CARL H. FUHRMANN
Superintendent Electric Meters Consumers Power Company, Jackson, Mich.

A MODIFIED form of Wheatstone bridge has been found of value in the meter department of the Consumers Power Company at Jackson, Mich., for balancing the resistances of potential coils used in polyphase meters. The device is also used for checking coils for short-circuited turns, loose connections, etc. The construction of the device will be apparent from the accompanying illustrations.

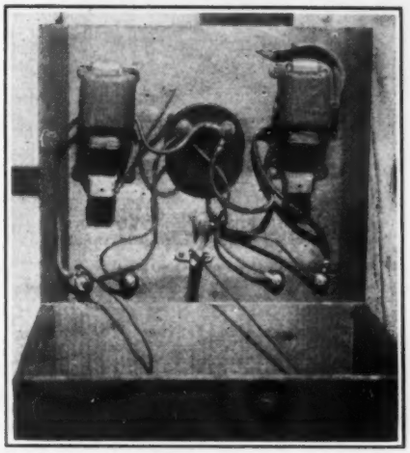


CONNECTIONS OF POTENTIAL-COIL TESTING BRIDGE

R_1 and R_2 are 120-volt potential coils. They are of about 275 ohms each. These two resistances must be exactly equal. G is a flush-type Weston ammeter, Model 301, 50 millivolts full scale, with shunt removed and resistance cut out of series with moving element. The scale of this instrument should have a zero center. B is a 45-volt radio B battery. K is a voltmeter button switch. T_1, T_2, T_3, and T_4 are voltmeter terminals. The bridge is housed in an 8½x8½x5-in. box.



EXTERNAL VIEW OF BRIDGE



ARRANGEMENT OF BRIDGE PARTS IN CASE

INSTRUCTIONS FOR USE

To check the resistance of a given pair of potential coils, connect the terminals of one coil across T^1 and T^2 and the terminals of the other coils across T^3 and T^4. Press switch K. If the coils are balanced as to resistance, there will be no deflection of the galvanometer. If one of the coils is open, the galvanometer will deflect off scale. If a number of turns are shorted out in one of the coils, the galvanometer will give a deflection proportional to the unbalance in resistance between the two coils.

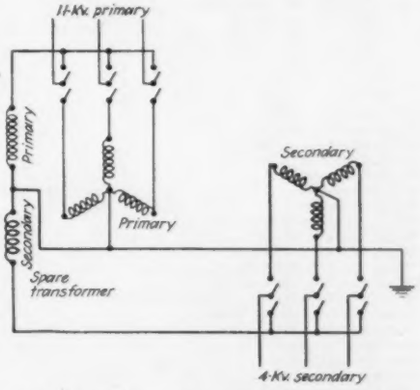
In balancing General Electric D-3 potential coils they should be connected as just directed, and the taps on the lower potential coil changed until the galvanometer shows no deflection. Then the tap should be soldered to terminal lead. In balancing meter for torque between elements the air gap should be adjusted by changing the relative positions of the current-coil laminations. This method eliminates the unbalance at light load usually experienced in a D-3 meter after it has been balanced at full-load unity power factor and lagged at full-load 50 per cent power factor.

The bridge can be used to detect a poor connection in a coil. This is determined by closing switch K and pressing firmly on one coil and then the other. If there are any poor connections in either coil, the galvanometer will flunctuate.

In order to insure the proper performance of this bridge it should be checked from time to time. This is accomplished by short circuiting T^1 and T^2 and T^3 and T^4. Then close switch K. If there is no deflection, the fixed resistances R^1 and R^2 are in balance. Care should be used to see that switch K is not left closed for any great length of time, as it will drain the battery. It is necessary to close the switch only momentarily to secure a deflection of the galvanometer showing an unbalanced circuit condition.

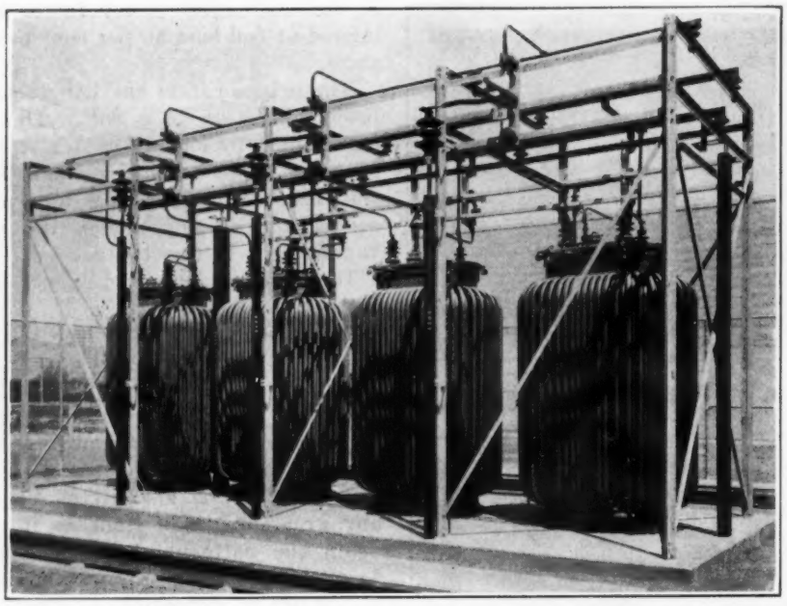
Special Disconnect for Spare Transformer

INSTEAD of using single-pole, double-throw disconnecting switches of the ordinary type for cutting in spare transformers, the Pacific Gas & Electric Company uses a special switch of its own design, which may be seen in the illustration on page 154. The particular feature of this switch is that it has two independent blades, each hinged at the lower end so that the charging current arc travels up clear of the blades and is easily broken. To accomplish this, it will be noted that the clip for the lower blade and the hinge for the upper blade are both mounted on the center insulator support.



CONNECTIONS FOR CUTTING IN SPARE TRANSFORMER ON 3,000-KVA. Y-Y BANK

For a Y-Y bank such as illustrated, the switching arrangement is very simple, only six switches being required, one for each leg of the 11-kv.



TWO-BLADE, SINGLE-POLE, DOUBLE-THROW DISCONNECTING SWITCH PREVENTS ARC FOLLOWING BLADE WHEN SWITCH IS OPENED

primary and one for each leg of the 4-kv. secondary. Connections for this particular transformer bank are shown in the accompanying diagram.

Cost of a Street-Lighting Extension

FROM the data sheets of a Massachusetts power company are taken the following itemized costs of extending series incandescent street-lighting service in a suburban town. The work was completed early in 1925 and the installation included 83 40-cp., 75-amp. lamps with necessary poles and fittings:

Safety Rules Developed by Employees

ONE of the principal reasons for the effectiveness of the little book of safety rules and instructions issued to the employees in the overhead division of the Commonwealth Edison Company, Chicago, is the manner in which the rules were compiled; another is the fact that they are continually under revision and are, therefore, up to date.

Realizing that safety rules, like all other rules of conduct, to be effective must be the expression of good judgment and experience, the management issued a tentative set of rules and instructions in mimeograph form; these were sent out to the line foreman for correction and changes. After careful consideration and discussion at foremen's meetings and by the men in all the line gangs, the copies were returned with the suggested changes and additions. These were acted upon by the general foreman and superintendent of the division and reissued to the men for further improvement.

The result of this process of safety-rule compilation not only is a set of rules that for clearness and pertinence is remarkable but it makes the employees feel that because of their experience in that particular work they have been consulted and have taken a part in compiling the rules that are for their own protection.

The practice of allowing the men at least fifteen minutes a week, "generally on Monday mornings," for a safety talk and the reading of one or two paragraphs of the safety book has done much to keep the safety rules in mind. At these periods the foremen assemble their men and discuss recent accidents, if any have occurred. The prone pressure method of artificial respiration is also demonstrated and practiced. If any rules are found to require revision, due to changes in specifications or construction methods, the recommendations are forwarded to the men's safety organization. If the majority of the men are in favor of the suggested change, the recommendation is sent to the divisional safety committee, where it is gen-

ITEMIZED COST SHEET FOR A STREET LIGHTING EXTENSION

Items	No.	Price per Unit	Sub-totals
35-ft chestnut poles	56	$12.59 +	$705.23
35-ft. cedar poles	49	20.15 +	987.36
40-ft. chestnut poles	10	16.08	160.80
45-ft. chestnut poles	3	22.33	66.99
4-pin crossarms	75	1.41—	105.72
6-pin crossarms	134	1.79+	240.39
8-pin crossarms	6	1.85	11.10
Wire, No. 6 weatherproof, ft.	40,957	0.02 —	811.42
Wire, No. 6 2,500-volt, rubber-covered, ft.	4,357	0.09 —	391.63
Wire, No. 6 15,000-volt, ft.	55	0.48 —	26.24
Wire, No. 6 5,000-volt, ft.	3,581	0.12 +	441.21
Wire, No. 8 2,500-volt, ft.	700	0.04 +	31.15
Wire, No. 8 twin, ft.	866	0.07 +	64.60
Wire, No. 10 5,000-volt single, ft.	12,846	0.08 —	1,023.34
Wire, No. 10 5,000-volt twin, ft.	9,942	0.12 +	1,227.60
Switches, 60-amp.	19	26.81 —	509.36
Switches, 150-amp.	10	68.13 —	681.26
75-amp. arc switch	1	.....	124.74
100-amp. arc switch	1	.....	59.33
Remote control switches	13	114.29	1,485.77
10,000-volt primary plug switches	12	8.11—	97.30
Test switches	8	6.00	48.00
Fiber conduit, ft.	1,493	0.15 +	228.88
Porcelain cutouts	.....	.....	16.90
200-amp. D & W oil cutouts	2	29.51	59.02
50-amp. D & W oil cutouts	17	15.39—	261.61
100-amp. expulsion fuse cutouts	4	11.22	44.88
Absolute cutouts	173	8.24 —	1,424.70
Cable, No. 6, 5,000-volt, ft.	1,340	0.16 +	217.83
Cable, No. 6, 7,000-volt, ft.	1,511	0.19 +	292.31
Cable, No. 6, 7,500-volt, ft.	52	0.19 +	10.04
Pipe, 1¼-in., ft.	214	0.14 +	30.41
Pipe, 2½-in., ft.	473	0.33 +	156.31
Pipe 3 in., ft.	71	0.44 +	31.53

Items	No.	Price per Unit	Sub-totals
Type S potheads	7	6.50 +	45.53
175-amp. potheads	4	6.94	27.78
Cable markers	538	0.07 —	36.91
Mast arms	375	15.90	5,963.83
Novalux units complete	870	24.97	21,724.58
Side lasts	165	2.68 +	442.37
Side gears	159	8.79 +	1,398.40
Back gears	2	4.40	8.80
Auto lightning arresters	4	5.04	20.16
1,000-cp. lamps	798	2.39 +	1,908.39
Arc lamp chain, ft.	3,706	0.033+	122.42
Pins, No. 8066	791	0.67 —	526.49
Insulators	524	0.465	243.66
Miscellaneous insulators	.....	.....	65.69
No. 350 brackets	11	1.15 +	12.69
"S" hooks	96	0.78 +	75.25
5-amp. meters	8	6.73	53.84
Meter boxes	8	9.00	72.00
20-kw., 2,300-volt, 6.6-amp. constant current transformers	7	420.00	2,940.00
35-kw., 2,300-volt, 6.6-amp. constant current transformers	12	554.00	6,648.00
15-kw. pole-type transformers	2	397.345	794.69
34-kw., 2,300-volt, 6.6-amp. constant current transformers	3	.....	1,626.57
Potential transformers, eight at $20.40	.....	.....	163.20
Labor	.....	.....	11,885.57
Auto charge	.....	.....	696.41
Trucking	.....	.....	289.67
Insurance	.....	.....	245.77
Storeroom charge	.....	.....	1,765.13
Miscellaneous items	.....	.....	1,975.95
Total cost			$73,854.71

Meter Dept.

Periodic Work Record 1926
The Worcester Electric Light Co. **Sheet No.**

Kind of Work-Location	Dept.	January		February		March		April		May		June		July		August		September		October		November		December	
		Due	Done	Due	Done	Due	Done	Due	Done	Due	Done	Due	Done	Due	Done	Due	Done	Due	Done	Due	Done	Due	Done	Due	Done
Test all municipal watt-hr meters				15	2-15					15	5-6-26					15	8-10-26					15			

TYPICAL ENTRY ON PERIODIC WORK SHEET

erally approved, adopted and ordered printed. Rather than reprint the entire book, inserts are made, and these are sent to all the men, who paste them in their books over the rule revised.

It is not unusual for a new man to question the validity of a certain rule and for an old timer to set him right. For instance, one may ask, "Why is a lineman prohibited from using tobacco while working on a pole?" It is explained to the man that using tobacco distracts his attention from his work and personal safety.

In addition to having a set of rules the men must be educated in their use in such a way that they will appreciate the importance of living up to them. The company has foremen who will, by close supervision, enforce the rules and who have no scruples about disciplining men who habitually violate them.

Recording Periodic Work at Worcester

TO INSURE that no important periodic work shall be overlooked in the operating department of the Worcester (Mass.) Electric Light Company, the assistant to the general superintendent has been made responsible for keeping adequate records of all such work and for its prompt execution. These records are kept on 10x25½-in. loose-leaf ledger type sheets numbered and assigned according to departments. Each routine task in inspection and maintenance is listed at the left-hand end of the sheet, and space is provided under each month of the year for indicating in black the date the work is to be completed and in red the date it is actually performed. Thus in the sample shown, the meter department is required to test all watt-hour meters on circuits serving municipal needs on Feb. 15 and quarterly. In the current year this has been twice completed a few days ahead of time. Entries are made in ink, and on jobs where the changing of oil is to be done with the inspection or other maintenance work this requirement is indicated in colored ink. This tabulation enables the general superintendent's office to make practically instantaneous checks of all routine work throughout an entire year. The binder containing the sheets is filed in the general superintendent's office, where it may be consulted by department heads or other interested persons. The periodic work record is kept on file for one year and then destroyed.

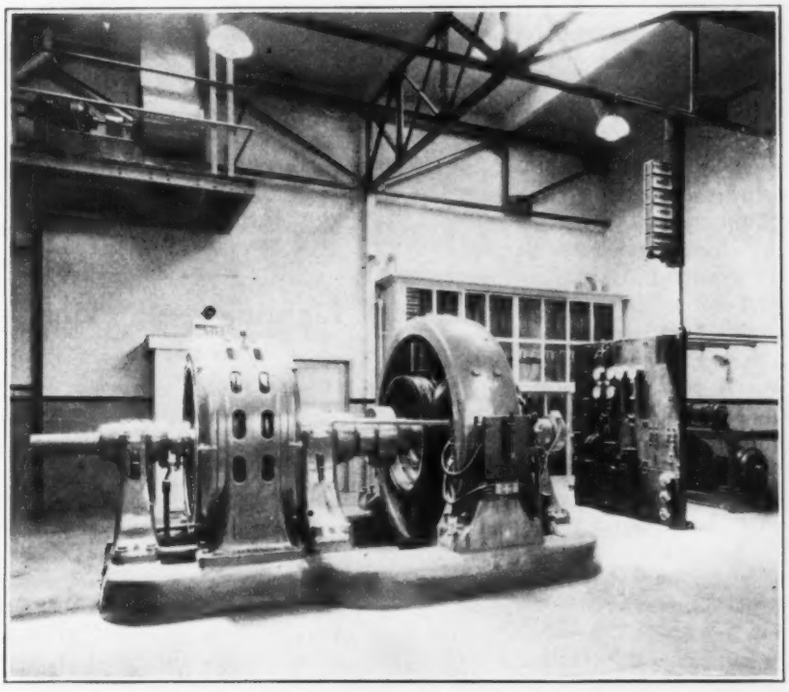
Thermostat Reduces Blower Operation

WHERE automatic substations contain rotating machinery, it is customary to have the ventilating fan start with the starting of the machine and continue to operate for twenty minutes after the machine has shut down. In the Hayward automatic substation of the Pacific Gas & Electric Company, which contains a 1,000-kw. rotary converter for street-railway service, it was considered desirable to have the blower thermostatically controlled to prevent its operation except at times when the temperature of the air made it necessary.

This was accomplished by placing a standard thermostatic relay of the helical coil bimetallic type on a building truss near the blower outlet in the ceiling. The thermostat is set to close its contacts at 85 deg. F. and open them at 60 deg. F., which in turn operates the starting relay of the blower motor. In order to prevent the blower fanning flames in case of fire its starting circuit is tied through the main starting switch of the rotary converter. Thus unnecessary operation of the blower is avoided.

Washing Dirty Insulators

INSULATORS exposed to acid or caustic fumes or fertilizer dust have frequently caused trouble. In one locality, where there are several large chemical and fertilizer plants, it was found that insulators had to be cleaned periodically. After trying out several methods it was found that washing the insulators with water and Sun Bright was successful. This is done about once every six months, depending upon the time that the equipment can be killed.



THE OPERATING TIME OF THE BLOWER FOR THE ROTATING EQUIPMENT IS REDUCED BY THERMOSTATIC CONTROL MOUNTED ON ROOF TRUSS

Commercial Activities and Public Relations

Detroit Edison Now Services All Electric Refrigerators

POWER-COMPANY support in servicing household electrical appliances is a strong influence in creating customer acceptance of these devices. Recognizing this principle and with the view to increase still further the use of electricity in the home, the Detroit Edison Company recently extended its service facilities to include electric refrigerators. For a number of years it has been this company's practice to maintain an extremely liberal policy in repairing customers' appliances, and it prides itself upon prompt response to trouble calls and requests for adjustment of appliances.

Inclusion of service on electric refrigeration was undertaken by the company only after its service men had been thoroughly trained in this kind of special service work. In its regular service work the company has 40 experienced electric service men on duty at all times, who are immediately available upon the call of customers through an efficient system of trouble dispatching. These service men were sent to the training schools of the various refrigerator manufacturers represented in Detroit and completed the courses for service men. Each man attended not one but several schools in order to familiarize himself with the different makes, and this was followed by further training and instruction in the company's own service department. They were then competent not only to take care of electrical trouble but also to rectify trouble arising in the mechanical side of the refrigerators.

For the most part the company expects to supply an emergency service on electric refrigeration rather than undertake major repairs, which will be handled by the dealers' service departments. It has been found, however, that with the Detroit Edison men able to respond to calls within 30 minutes at all hours of the day or night, customers will be assured of continuous operation of refrigerators.

The Detroit company's extension of its service facilities to domestic electric refrigerators is expected to lend a strong impetus to the use of these devices. Electric refrigerator dealers recognize this influence in building confidence in the public mind, and the accompanying advertisement, which appeared in the Detroit daily papers under the name of the Strelinger Copeland Company, indicates the dealer's appreciation of the value of this service.

The Detroit Edison Company, which does nearly all of this work free of charge for the customer, feels

Important Announcement to Detroit Users of
Copeland Dependable Refrigeration
Detroit Edison Service Available Day and Night
Effective immediately, the emergency service facilities of the Detroit Edison Company are at the disposal of all Detroit owners of Copeland Dependable Electric Refrigeration.
Forty experienced Detroit Edison electricians have been given an intensive course of training in the Copeland school. These men are available to you at all hours of the day or night, and are prepared to promptly rectify all minor troubles. This is an extension of Detroit Edison well known service to all Detroit Copeland owners.
Call Detroit Edison Trouble Department, Randolph 7100, and an Edison expert will be at your door with his usual promptness.
This new and convenient facility is in addition to the usual Strelinger Copeland service, which will be maintained in its present high state of efficiency, ready to respond to all calls as usual. For Strelinger Copeland service call Glendale 4690.
Copeland Dependable Refrigeration is all that the word "dependable" implies. It is unusually trouble-free. These two emergency services, the finest in America, are offered as an added insurance of satisfaction to all Detroit owners of Copeland Dependable systems.
The Strelinger Copeland Company
4490 Cass Ave., Convention Hall Glendale 4690
Copeland
DEPENDABLE
REFRIGERATION

HOW REFRIGERATOR DEALER ADVERTISES POWER COMPANY'S SERVICE ON ELECTRIC REFRIGERATION

that only by keeping appliances in good working order all the time will customers continue to use them and be encouraged to purchase and use others.

Lighting "Ads" Yield Returns

ADVERTISING material sent to prospective factory and store improved-lighting customers by a New England central station at a cost of $32 recently yielded the following results: Two hundred stores were circularized and ten replies were received, resulting in the addition of 3.95 kw. additional load with an estimated increment of 10,300 kw.-hr. per year at $934 revenue. Four hundred and twenty-five factories were likewise communicated with. Thirteen replies came through, 32.4 kw. in new load was connected and 20,000 kw.-hr. per year added, with $2,375 in augmented revenue.

Cost and Results of Orchard-Spraying Plants

Experience Available in California and Washington with Motor Driven Plants Shows Many Advantages Over Portable System—Cost Data Given

DURING the past few years orchardists of California and Washington have taken a great deal of interest in stationary spraying plants for doing away with the portable system that has been in vogue for many years. A stationary system consists of a central pumping station and pipe lines laid systematically throughout the orchard, with outlets at regular intervals, to which hose is attached for spraying the trees. The piping system is usually laid underground, although some installations have been made with the pipe laid on the surface of the ground or even installed overhead.

Considerable data are now available on electrically operated stationary spraying plants from surveys made in California and Washington. A progress report[1] just published by the University of California in cooperation with a sub-committee of the State Committee on the Relation of Electricity to Agriculture gives the following information concerning five electrically driven installations investigated:

Installation cost per acre (based on 628 acres)	$47.00
Installation cost per tree (based on 53,800 trees)	0.56
Electrical energy cost per acre (based on 388 acres)	0.099
Power cost per tree (based on 28,044 trees)	0.0137
Average operating cost per acre for single spraying (all operating charges)	10.38
Average operating cost per tree for single spraying	0.144
Total average cost per acre for five sprayings per year (fixed charges based on a system life of fifteen years)	11.32

Records[2] obtained by the State College of Washington from the power company show the following figures for the Wenatchee apple district of Washington:

[1] Bulletin 406, University of California, College of Agriculture, by B. D. Moses and W. P. Duruz.

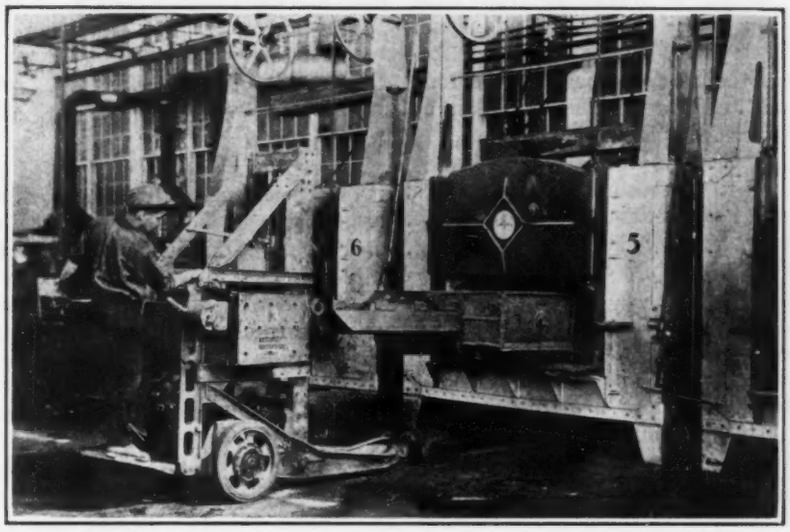
[2] From paper entitled "The Stationary Spray Plant," by Harry Lee Garver.

Number acres under stationary spray	1,278
Kilowatt-hours consumed for year 1925	60,623
Total revenue	$3,762.15
Connecting and disconnecting	339.50
Average cost per acre per season (revenue only)	$2.94
Average number of sprays per season	7.35
Average cost per spray	$5.18
Average cost per acre per season	$3.13
Average size of motor used, hp	5
Average horsepower per acre required	0.376

In the Wenatchee district the cost of stationary and portable spraying plants is about on a par. Farmers report that they are able to do their spraying in about half the time with the stationary outfit that was required with the portable rig. Wear and tear on machinery is less and ditching in the orchard is not damaged. Other advantages shown by the California report are: It is possible to irrigate and spray at the same time; danger of knocking off fruit on low-hanging branches is minimized; hillside orchards may be sprayed easily; intercrops or permanent cover crops are not injured, since tractors and teams are not required; electrical energy may be used, which is more convenient than gasoline power; 95 per cent of the time is used in spraying; the system is a permanent improvement to the property.

Further investigation is to be made in both Washington and California of stationary spraying plants.

Six Electric Furnaces of This Type Have Replaced Seven Coal-Fired and Five Oil-Fired Outfits



THIS installation is used in heat-treating steel castings at the Whitin Machine Works, Whitinsville, Mass. Hardening and carbonizing are done in ten hours during the day and annealing for fourteen hours at night. The carbonizing and annealing boxes are handled by an automatic industrial electric lift truck and usually hold 650 lb. each. These furnaces (Hagan) have been in continuous operation 24 hours per day and five and a half days per week for the past three years without shutdown for repairs. Rejections of work have been cut from 15 or 20 per cent to zero; production in three leading departments has been increased from 10 to 20 per cent owing to improved quality of heat-treatment. The net saving to the Whitin company from the investment in these six electric furnaces exceeds $16,000 per year.

Electric Truck Saves Money in Boston Ice Delivery

BY N. D. HERRICK
Electric Transportation Division, Edison Electric Illuminating Company of Boston

EXPERIENCE with a five-ton Commercial electric truck purchased early in 1926 by the Metropolitan Ice Company of Boston for use in the wholesale market district indicates a yearly saving of about $7,000 over the cost of horse haulage. In Boston, as elsewhere, the ice-delivery business has always been one of the strongholds of horse traction. The use of electricity in large-scale refrigeration has prepared the minds of many ice-company executives for electric trucking, and interest is rapidly increasing in this most modern of methods.

This pioneer installation is used in large part in the heavily congested market district of the city, which is handicapped by narrow, winding streets with poor surfaces. Traffic is so heavy here that it often approaches the saturation point, and it is not unusual for a driver to spend an hour and a half in going 350 feet. For this reason it was deemed highly experimental to use a high investment vehicle (costing around $5,600) to do this work. In 1925 the work was handled by two two-horse teams with three men per wagon, overtime being often required.

The volume of business handled in 1926 was greater than in 1925 and was cared for by this one electric truck. Except in periods of extreme peak, only three men worked with the truck. Not only was the additional work handled with ease but the men finished their work earlier in the day. The satisfaction of the men finds a counterpart to a still greater degree in the satisfaction of the owners.

The savings due to the use of this truck are very pronounced. First, three men are doing the work formerly handled by six. Stable labor

THIS ELECTRIC TRUCK PAID FOR ITSELF IN TEN MONTHS

has also been reduced and valuable space released for other purposes. Figured at $33 per week per man, the saving in wages is more than $5,000 a year. There is an additional saving, which is the difference between the cost of operation of four horses and two wagons and that of the electric truck.

The cost of horse operation is difficult to determine. Horse owners usually keep but few costs, and those expenses that are kept are items that enter directly into the cost of operation. Perhaps the best method of arriving at the actual cost of horse operation is to take the figures for which a team and wagon can be rented and allow a percentage of profit in such business to the horse operators.

A two-horse team and wagon with a working driver can be rented in Boston for $75 per week. Allowing $33 per week as the driver's wage, the cost of the team and wagon can be figured at $42 per week. If a 15 per cent profit to the horse owner is allowed, the actual cost of the team and wagon is $1,850 per year. Since the five-ton electric replaced two teams, the ice company would have spent $3,700 during this year on horse expenses had the change to the electric truck not been made.

A liberal estimate of total cost of operation of the five-ton electric truck is shown in the accompanying table.

Depreciation of chassis (fifteen years)	$260
Depreciation of battery (forty months)	338
Interest on chassis investment	125
Interest on battery investment	43
Insurance	201
Taxes	87
Registration	65
Garaging, battery charging, power, minor adjustments, battery attention, etc.	720
Miscellaneous expenses	100
Total	$1,939

This particular truck is garaged at a public garage under a flat rate that covers garaging, washing, minor adjustments and repairs and battery attention. Battery-charging power is also included in this flat energy consumption rate.

The cost of operating one two-horse team and wagon is very nearly that of operating this five-ton electric truck. It must be borne in mind that the electric is garaged at a profit to the public garage. Trucks garaged privately lower this computed cost considerably.

A summary of the savings to the ice company due to the use of this truck shows:

	Saving
Wages, (approximately)	$5,000
Previous horse costs	2,000
Total estimated saving per year	$7,000

Although the truck is rated to carry 10,000 lb. by the manufacturer and 11,500 lb. by the operator, it is a common occurrence to load the truck with 18,000 lb. of ice.

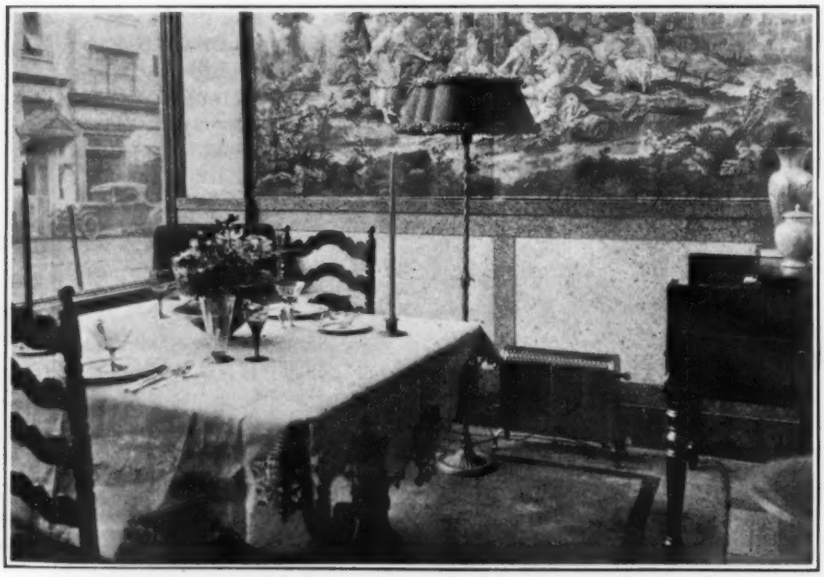
Life and Disability Insurance for Employees

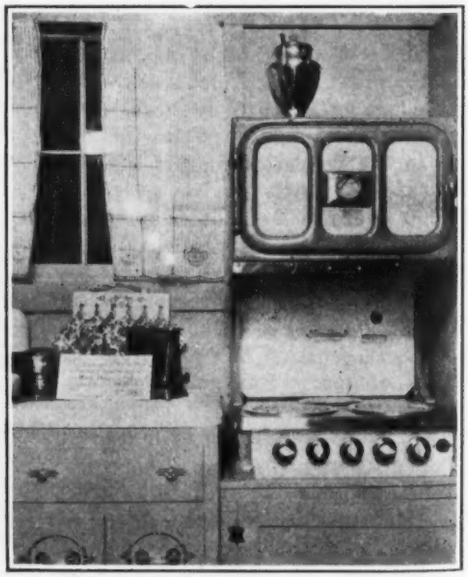
AN ARRANGEMENT combining life and disability insurance protection for its employees in one policy has recently been evolved by the Puget Sound Light & Power Company, Seattle. About 600 employees are eligible to participate and if 50 per cent avail themselves of approximately one-half the maximum allowed, as is estimated by insurance officials, the total group policy will amount to a sum in the neighborhood of $5,400,000.

Briefly, the agreement permits any employee now in the service of the company between the ages of 15 and 69, or any employee entering the service hereafter between 15 and 45, to secure insurance in the event of death or total and permanent disability, and at the age of 70 a substantial life annuity at very favorable premium rates. A portion of the premium is paid by the company, the amount ranging from 25 per cent for employees up to 33 years of age to 75 per cent for employees who are 67 or older.

The amount of insurance coverage under the plan varies with the length of service of the employee. Provision is made for additional insurance to be taken by the employee. Premiums on the policies are collected by regular reductions from the pay of the employees.

Suggests Hotel-Apartment Equipment in Window Display





IT WAS particularly gratifying to the Great Western Power Company to note the number of women who were attracted to a recent window display in its San Francisco district office. The front portion of the window indicated what is possible in the way of furnishing a breakfast room in a modern high-class apartment or hotel-apartment. The rear of the window held a model of the kitchenettes in the new $5,000,000 Mark Hopkins Hotel in San Francisco.

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Hydro-Electric Plant in Chancy-Pougny.—M. BARRERE.—This article describes a modern low-head hydro-electric power plant in France, which is the latest station to be added to the French 120-kv. national power bus. A river drop of 19 ft. supplies five horizontal waterwheels, each directly coupled to a 7,000-kva. umbrella-type three-phase generator rated at 11,000 volts, 50 cycles. The low speed of 83.3 r.p.m. required 72 poles per rotor, which gave the generator the unusually large outside diameter of nearly 30 ft. and a complete weight of 220 tons. To facilitate transportation, rotor and stator are both made in four quadrants joined in field. At full speed the rotor develops a moment of inertia of 2,000,000 kg.m.^{2}. Compressed-air brakes are installed to permit stopping the generator quickly. A carefully designed thrust bearing is installed above the rotor and directly under the 100-kw. exciter. A special motor-driven fan supplies each unit with forced-air cooling. At unity power factor and 7,000 kva. load, an over-all efficiency of 95.6 per cent was measured, decreasing at half load to 93.9 per cent. A very large part of the article is devoted to minute descriptions of methods used to carry out the final customers' tests on the installed machine, all data being given in tabulated form or performance curves.—*Revue Générale de l'Electricité*, Oct. 30, 1926.

Generation, Control, Switching and Protection

Excitation of Exciter Dynamos.—KURT LUBOWSKY.—This is a brief discussion concerning the advantages accruing through the use of shunt-wound exciters as compared with the use of compound machines, which is the general practice in the United States. Several considerations are enumerated to show that the foreign engineering practice is justified.—*A. E. G. Progress*, November, 1926.

Ozone Generation in Turbo-Generators.—L. KNOPFF.—Forced-air cooling of large high-speed generators is frequently arranged in such a way that essentially the same volume of air is used over and over again in a closed circulating system. Fear has been expressed that this volume of air may become laden with a dangerous amount of ozone, which in turn may change into nitrous acid and damage the insulation of the generator. Investigations were made to determine the extent of this danger. Ozonization of air does not occur below a stress of 20,000 volts per centimeter, for which reason 6,600-volt generators must not be considered at all. For voltages of 11,000 or more the oxygen of the cooling air may actually be dissociated. On a 20,000-kva., 11,000-volt generator the presence of ozone was readily discernible by odor. After three hours of operation chemical analysis gave positive proof of O_3, which on measurement proved to be 0.00032 per cent of the total amount of air—140 cu.m.—in the cooling system. This pollution is so small that appreciable danger does not exist, particularly since after three days of continuous operation no increase of the ozone component could be found.—*Siemens Zeitschrift*, November, 1926.

Transmission, Substations and Distribution

Notes on Transformer Polarity and Connections.—JOHN AUCHINCLOSS.—In the November issue of the *General Electric Review* the author described the fundamentals involved in determining the polarity of individual transformers by employing alternating current and direct current and explained how these fundamentals are applied to ascertain the proper connections for delta-delta and YY transformer groups. In this installment he discusses the other common group forms in some detail.—*General Electric Review*, December, 1926.

Caloric Tests on Transformer Radiators. — OERLIKON LABORATORY. — The necessary cooling surface on large self-cooled transformers is provided in the shape of multi-tube radiating units, which are attached to the main tank. The hot oil enters these units at the top and distributes itself in the many air-surrounded tubes, where it cools off. This increases its density and establishes a downward flow, re-entering the main tank at the bottom. When many of such radiators are crowded around a tank, the free access of air is somewhat hindered and the cooling efficiency per unit becomes less. Careful tests are described in this paper showing the efficiency of such radiators under various conditions. The tested radiator was 12 ft. long and contained 68 thin-walled iron tubes each of 1-in. diameter. A small oil pump was provided to enhance the circulation of the oil in the radiator. To imitate restricted access of air, large wooden partitions were placed at one or both sides of the radiator. Complete tabulations give all the data obtained.—*Bulletin Oerlikon*, No. 61-62, 1926.

Units, Measurements and Instruments

Determination of Rotational Velocity.—T. A. BORDEN.—There are a number of tests which require that the speed of a unit under investigation be varying and that the important observations be made while this variation is in progress, the law of change being a controlling factor in the final results. Among these may be mentioned hydraulic turbine studies, governor investigations and a determination of no-load losses of electrical machinery by retardation tests. Various forms of centrifugal, fluid, magnetic and electrical tachometers have been developed, but when there arises the necessity of reading and recording rotational velocities while these are undergoing change most of such devices suffer from various handicaps, the principal being perhaps the inertia of the mechanism of the instrument or of the recording apparatus. With these difficulties in view the application of a chronograph to certain measurements was undertaken, and this article describes the principles of operation and their application to practical conditions. Particular advantages to be obtained by the use of the chronograph are listed.—*Electrician (England)*, Dec. 24, 1926.

Electrode Effects in the Measurement of Power Factor and Dielectric Constant of Sheet-Insulating Materials.—E. T. HOCH.—In this paper it is shown that, aside from the guard-ring type of electrode, which can be used only with certain special types of measuring circuit, the most accurate results can probably be obtained by the use of equal-foil electrodes and making proper allowance for the edge effects. From the standpoint of convenience, mercury electrodes and foil electrodes of unequal size have certain advantages. It is believed that the results obtained with these two types are also sufficiently accurate for most purposes when the corresponding corrections are applied.—*Bell System Technical Journal*, October, 1926.

Illumination

Tungsten Arc Lamp.—H. PÉCHEUX.—A French concern has placed on the market a novel type of lamp which, inclosed in a glass bulb, operates on the arc-lamp principle. Two very minute balls of tungsten are held rigidly about 1/25 in. apart, forming the electrodes of a 220-volt alternating-current circuit. In series with these balls is a fixed resistance of 75 ohms, while in parallel to the main electrodes are placed two pointed magnesium electrodes, also with a very small gap between them. This auxiliary gap forms a second circuit with 6,000 ohms fixed resistance in series with it. The two gaps and the two resistors are sealed into a tubular glass bulb with an ordinary lamp base at one end. A rarefied monatomic gas fills the bulb. Applying 220 volt alternating current to this lamp causes the auxiliary gap to arc over, which acts as an ionizing agent for the main gap. Soon thereafter the main gap will pass current and the ensuing arc will heat the tungsten balls to a bluish white, emitting some 2025 bd. (bougie-decimal or French decimal candles). From the instant of closing the switch the current consumption rises from 0.2 amp. to a permanent value of about 2 amp. The efficiency of the lamp is 0.81 watt per bougie-decimal. A large part of the paper describes photometric measurements made on this lamp.—*Revue Générale de l'Electricité*, Oct. 16, 1926.

Introduction to Color Lighting.—R. GILLESPIE WILLIAMS.—Color lighting is assuming a considerable degree of importance. According to the author, it will soon rank in the home as of equal importance with decorative schemes; its psychological value will be used in industry; architecturally it will be used to enhance decorative features, while in theaters, motion-picture houses and

dance halls it will be indispensable. At the present time the biggest field for color lighting lies in the latter three places. A very interesting and informative discussion is presented in this article of the effects which can be obtained by the mixing of colored lights and some of the essential considerations which must be observed to assure the desired results.—*Electrical Times (England)*, Dec. 16, 1926.

Motors and Control

Eddy Losses in Armature Conductors.—L. DREYFUSS.—Large machines with open slots have, under certain circumstances, additional losses due to a phenomenon which does not occur to any appreciable amount on small machines. The magnetic flux in the air gap between rotor and stator enters to a considerable extent, not only through the slot wedge, but into the conductors in the slot, which may cause such excessive eddy-current losses that preventive measures must be taken. In some cases it may suffice to place the turns deeper in the slot, but usually a subdivision of the conductor will give more positive relief. Slot wedges of magnetic material may be mentioned as a possible help, but their design has not advanced sufficiently to permit use on large machines. Whichever method is chosen to counteract this phenomenon, it will first be necessary to calculate these additional losses. The author employs the method of "conform reproduction," according to the theorem of Schwartz, to calculate the air-gap flux and its distribution. On two examples—one a 24,000-kva. generator, the other an 830-hp. single-phase commutator motor—the equations from the theoretical part of the paper are applied to practical designs.—*Bulletin de l'Association Suisse des Electriciens*, October, 1926.

Heat Applications and Material Handling

Electric Temperature Measurements on Diesel Engine.—R. SULZER.—Very valuable data were obtained on the internal thermal conditions of a two-cycle Diesel engine during its normal operation by a novel arrangement of thermocouples and a photographic recording of their potential by an oscillograph. Thirty copper-constantan couples were distributed in various parts of the cylinder and the piston of a 1,350-hp., 100 r.p.m. Diesel motor. Being made of very fine wires, these couples responded almost instantly to the ambient temperature. A very delicate and highly sensitive gold-string galvanometer was arranged to be connected over a set of selector switches to any one of these couples, and its deflection was recorded on a revolving film drum. It was thus possible to obtain complete temperature records of the heat conditions inside the combustion chamber of the Diesel motor during the operating cycle of the piston. It is of interest to see the widely varying heat cycles at points of the piston or cylinder which are relatively close to each other. It is also illuminating to see what difference varying load of the motor has upon the occurring temperatures. Practical research of this nature is a great boon to the further development of Diesel motors.—*Revue Générale de l'Electricité*, Dec. 4, 1926.

Electrophysics, Electrochemistry and Batteries

Some Properties of Electrolytic Iron.—G. P. FULLER.—Electrolytic iron has been manufactured in commercial quantities by three different companies in the United States, namely, the Westinghouse Electric & Manufacturing Company, the Western Electric Company and the Niagara Electrolytic Iron Company. The two former, according to the author, produce a brittle sheet deposit, which is broken up for remelting or pulverization, especially for electrical use, while the latter manufactures seamless iron tubing, which it markets as such. The present article deals only with the product of the last-mentioned plant, and principally with a discussion of the physical properties of the material.—*American Electrochemical Society*, October, 1926.

Electroplating on Iron and Steel.—W. E. HARRIS.—Electroplating of iron and steel calls for special methods, particularly in the preparing of the work before the actual plating can be done. The author details practical requirements and applications in this work, with an enumeration of the essential precautions to be observed. He gives details of various plating solutions, devoting special attention to chromium plating and tinplating processes.—*Electrician (England)*, Nov. 26, 1926.

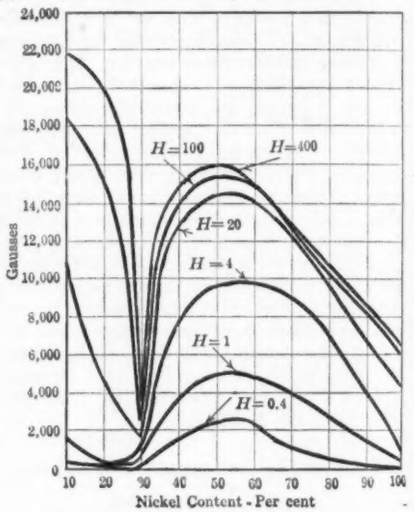
Telegraphy, Telephony, Radio and Signals

Loading for Telephone Cable Circuit.—D. W. WHITNEY.—This paper is a summary of the principal characteristics of the loaded telephone line and a discussion of the major improvements in such loading.—*Bulletin Reprint B-212, Bell Telephone Laboratories*, November, 1926.

Portable Radio Direction Finder for 90 to 7,700 Kilocycles.—F. W. DUNMORE.—This paper describes the development of a portable radio direction finder with but two controls—balancing and tuning—which operates over the frequency band from 90 to 7,700 kilocycles. A shielding aluminum box contains all the receiving apparatus, including batteries, with the exception of the direction-finder coil, which is supported on a bakelite shaft extending through the box and rotated by means of a hand wheel under the box. A wide frequency range is made possible by a set of seven interchangeable plug-in direction-finder coils, each with a corresponding heterodyne generator coil and a cam for operating the auxiliary tuning condenser. Another automatic condenser is connected in parallel with the main tuning condenser and is operated by a second cam of a shaft of the balancing condenser. Its function is to compensate for the detuning effect produced at the higher frequencies when the balancing condenser is operated. The center of each direction-finder coil is grounded to the shield when in use. A small telescoping brass rod, extending vertically through the center of each direction-finder coil, connected to the movable plates of the balancing condenser, serves as an auxiliary antenna for the purpose of sharpening the point of minimum signal. Means are provided so that bearings may be taken with respect to magnetic north.—*Bulletin No. 536, United States Bureau of Standards.*

Miscellaneous

Nickel-Iron Alloys.—W. T. GRIFFITHS.—Iron and nickel being two of the three metals which alone show any well-marked magnetic properties, it is not altogether a surprise to find various alloys of these metals also displaying such properties. The uses to which these alloys may be put are many and varied, especially in connection with telephone and telegraph electrical engineering. Their high permeability combined with low hysteresis loss and high resistivity make them invaluable for such purposes as relays, telephone receivers, transformers, electromagnets and certain measuring instruments. The electrical resistivity of the alloys varies considerably with composition, so that numerous combinations of resistivity and magnetic properties are possible. All the nickel-iron alloys containing between about 35 and 80 per cent nickel show a low hysteresis loss and coercive force, and it is of interest, according to the author, to note that the 36 per cent alloy known as "invar," which is remarkable because of its low coefficient of thermal expansion, has also been used in certain delicate relays in virtue of this low coercivity. The nickel-iron series is notable not only for its magnetic properties, but also for the fact that it includes alloys having very varied coefficients of thermal expansion, from virtually zero upward. The alloys as a whole and others related show a considerable degrees of resistance to corrosion of certain types, while other alloys, such as "elinvar," containing 36 per cent nickel and 12 per cent chromium, show very little change of elastic properties with change of temperature.—*Electrician (England)*, Nov. 26, 1926.



FLUX DENSITY FOR VARIOUS MAGNETIZING FORCES

News of the Industry

Approve Indianapolis Plan

Public Service Commissioners Authorize Merger of Companies, with Capitalization of $40,000,000

AN ORDER authorizing the consolidation of the two Indianapolis electric light and power utilities—the Indianapolis Light & Heat and the Merchants' Heat & Light—with a capitalization of $40,000,000, instead of the $55,000,000 asked, was issued by the Indiana Public Service Commission late on Jan. 8. The order follows an agreement reached a short time before between Harley L. Clarke, principal figure in the consolidation move, the Indianapolis Chamber of Commerce and a group of large users of power. The order was written by Frank B. Wampler, commissioner in charge of the case, and was adopted unanimously.

The commission's order said in part: "The commission feels amply justified in adopting for the purposes of this cause, as of Sept. 30, 1926, a value of $40,000,000. . . . The orders herein issued with respect to the value of these combined properties will be interlocutory in nature, and the commission at a later date upon its own motion or upon a proper petition may make further inquiry to determine whether the value herein found is entirely correct. No one who has the faintest conception of the present competitive situation believes that rates can ever be reduced to the most economical point so long as the competitive situation continues, and if the competitive situation were to continue for ten years, the problem would be even more complicated than it is now. The evidence clearly shows that a considerable saving can be effected in the unified operation of the two properties. One group of officers, engineers, accountants and clerks can be eliminated entirely. The continued maintenance of duplicate property will be avoided and the waste of money in competitive effort to get new business will be ended."

The new consolidated Indianapolis utility, the Indianapolis Power & Light Company, has adopted a domestic lighting schedule making a reduction of ½ cent in the rate for the second block of 25 kw.-hr. and larger reductions for consumption in excess of this. The rate for the first 25 kw.-hr. remains at 7½ cents.

Philo to Install 165,000-Kw. Turbo-Generator

The American Gas & Electric Company announces the purchase for the Philo plant of the Ohio Power Company of a steam generating unit with the extraordinarily large rating of 165,000 kw. The installation of this unit, complete with boilers, housing, coal-handling apparatus and high-tension transformers, calls for an expenditure of approximately $17,000,000. With it the Philo plant will have a total capacity of 245,000 kw. The Philo plant is near the center of Ohio on the Muskingum River, on the western edge of the Ohio coal fields. The initial installation of 80,000 kw. was made two years ago. With the Windsor, Twin Branch, Cabin Creek, Kenova, Glen Lyn and Logan plants, it feeds one high-tension transmission system which extends from Michigan through Indiana, Ohio and West Virginia to southern Virginia and Tennessee on the south and the Ohio River on the east and is interconnected with Chicago, Toledo, Cleveland and Pittsburgh lines, making it rank among the largest interconnected power systems in the world.

N.E.L.A. Apparatus Committee Meets at Birmingham

The electrical apparatus committee of the National Electric Light Association met in Birmingham, Ala., Jan. 11 to 13 with a total attendance of 70, representing light and power properties in every geographical section. Vice-Chairman J. M. Oliver presided on account of the illness of Chairman H. R. Woodrow. The chief topic of discussion was the operation of interconnected systems. Representatives of the larger power companies presented an outline of the methods in force on their respective systems, and an active discussion covered the importance of making interconnection contracts in such a way as to permit the operating staffs to realize upon the economies made possible. Constant frequency and the use of primary tie lines were accented as essential to successful operation. System load dispatching and maintenance methods were discussed with respect to their effect upon operation. Committeemen inspected Mitchell and Martin Dams and Muscle Shoals.

New York Republicans Father Compromise Hydro Plan

Assemblyman Willis H. Sargent of Syracuse has introduced in the New York State Assembly a measure to create a temporary commission of eleven members to report to the Legislature of 1928 the best method of developing state-owned water power. The measure is said to have been introduced as a "feeler" to develop sentiment in the Legislature, or as a compromise with the Governor, who desires to create a State Power Authority.

The bill contemplates a commission composed of eleven members, of whom two would be Senators appointed by the Republican leader of the Senate, one a Senator appointed by the minority leader of that house, three Assemblymen to be named by the Speaker from among the Republicans, one an Assemblyman proposed by the Democratic minority and two persons selected outside the Legislature and named by the Governor. In addition there would be one financial and one engineering expert. It is thought likely at Albany that a substitute bill will be introduced naming a commission of prominent citizens and experts containing no member of the Legislature.

Refuses 48 Charters

Pennsylvania Companies Planning Rural Extensions Are Sharply Criticised by Governor

STATE charters were refused by Governor Pinchot of Pennsylvania to 48 electric light companies on Wednesday, Jan. 12, and granted to 26. The Governor, basing his action on a report of Public Service Commission engineers, charged that the 48 companies failed to recognize that their fundamental duty was to furnish service to the public. The companies affected were asking charters for districts in many parts of Pennsylvania. In many instances no lines have been built.

The engineers, who made an investigation to determine reasonable charges for service under the commission's General Order No. 27, reported that any charge is unreasonable which exceeds 9 cents per kilowatt-hour for rural service where there are five and one-half consumers or more per mile, each consuming 100 kw.-hr. per month, and only such applications were approved as conformed with that as a minimum rate.

"The existing companies seeking these charters," said the Governor's statement, "have sought by one subterfuge or another to avoid the effect of General Order No. 27 of the Public Service Commission, requiring each company to extend its lines upon the application of prospective customers pledging themselves to take the service thus afforded. The principal purpose of this order was to make available to rural Pennsylvania the advantages, comforts and conveniences that are dependent upon electricity. The companies fought this order in the courts. They were beaten, and now they have sought to escape the effects of the order by filing prohibitive rates for this type of service, or in some instances by ignoring the mandate of the Public Service Commission requiring them to submit their tariffs under General Order No. 27. Until these companies recognize their duty to furnish electricity at reasonable rates to every citizen of Pennsylvania who seeks it they are not entitled to any new charters."

The Governor commended the rates of the Philadelphia Electric Company and by implication found those of the Philadelphia Suburban Gas & Electric too high. The application for a merger of the latter with the Counties Gas & Electric Company of Norristown was denied.

Imperial Valley in Danger?

Civil Engineer, Advocating Boulder Dam, Holds that Situation Demands Immediate Action

"DANGERS to the Imperial Valley are such that if corrective work on the levees and in the river channel is not at once done, there may be no occasion for building a flood-control dam later so far as this valley is concerned," declared J. C. Allison, an authority on irrigation and flood-control problems of the lower Colorado River basin, in speaking recently before a meeting of the American Society of Civil Engineers at Los Angeles. "Legislation contemplated in the Swing-Johnson bill in its present amended form is the vehicle which most people have accepted as the means of bringing about federal action in the work of constructing, first of all, some sort of a flood-control dam.

"Coupling of an all-American canal for the Imperial Valley in the same measure with the building of a flood-control dam originally prevented action in passing a bill through Congress for building the dam itself," he continued. "Now the failure of Arizona to ratify the seven-state compact, taken with California's provisional ratification of a six-state compact, quite effectually blocks legislation. The excuse for all of these obstructions is the pretended insufficiency of water supply in the river. Hence the obstruction to the passage of the Swing-Johnson bill because of the fear that Mexico will rob California of water, that California and Mexico together will rob Arizona of water and that the whole lower basin combined will rob the upper basin."

The speaker went on to say that "the only remedy to the situation, if there is to be an Imperial Valley to save with a Boulder dam or any other dam, is certain work on levees and the construction of a new channel." The work involved is of such magnitude that it can be accomplished only through federal agencies, he maintained.

Swing-Johnson Bill Attacked

Many Reasons Against Federal Government Construction of Boulder Dam Advanced in Minority Report to Lower House—N.E.L.A. Takes Hand in Fight

ARIZONA'S opposition to the Swing-Johnson bill for the construction of a dam by the federal government at Boulder Canyon on the Colorado River, to serve the triple purpose of flood control, irrigation and generation of power, is expressed by Representative Carl Hayden of that state in a minority report. This bill has been favorably reported in both houses at Washington. Mr. Hayden makes ten contentions, which may be briefly summarized as follows:

1. The bill violates the law in authorizing the nation instead of the states to appropriate water.

2. Only complete agreement between the United States and the seven Colorado Basin states, or else a Supreme Court decision, could bring about a valid apportionment of the water.

3. Arizona, after conceding to Nevada all the water that state can ever use, asks for an equal division with California of the remainder. In agreement with Nevada, Arizona asks the right to collect each year from any hydro-electric power produced by the federal government a sum equal to the taxes which would be paid if the same site were owned and developed by private enterprise.

4 and 5. In the absence of a treaty with Mexico for apportionment, the dam would benefit that country to the injury of Arizona and enable Mexico to produce cotton and farm products that would compete in American markets.

6. The bill, although appropriating $125,000,000, has not been recommended by the Director of the Budget.

7. The bill is falsely represented as a reclamation act, whereas in truth its primary purpose is to create a government hydro-electric plant.

8. Flood control, the need for which is universally acknowledged, is only an incident to the major purpose of the bill. Flood control could be secured for less than one-third the sum.

9. Los Angeles' water needs for domestic purposes can be better supplied from the Sierra Nevadas.

10. The bill is sure to result in protracted litigation. Arizona will fight it.

Another minority report, filed by Representative Leatherwood of Utah, declares that the bill is a departure from traditional policy, puts the government into the power industry on a gigantic scale, reverses the policies of the Federal Power Commission, the United States Geological Survey and the War Department, and represents a political solution of an economic and engineering problem of the first magnitude vital to a great section of our country.

An interpretation of the Swing-Johnson bill in "an effort to show wherein the measure provides the possibility of the government entering the power business on a large scale" has been prepared by the department of public information of the N.E.L.A. and issued to member company executives. "It would appear," this statement says, "that if the facts were generally known to the press and public, there would be a general opposition to the government undertaking this project in the face of the immediate pressing necessity for a smaller project for flood control and the protection of the Imperial Valley." The N.E.L.A.'s document calls Boulder Dam "the most ambitious experiment in government ownership and operation ever advanced for public acceptance," throws doubt on its engineering possibility in view of its great height—600 ft.—and the annual floods on the Colorado, doubts that the sum appropriated would prove sufficient, and calls "fantastic" the idea that this sum can be recouped by sales of electricity.

Asks Increased Power

New York Commission Wants Jurisdiction Over Holding Companies and Electric Sub-Meters

COMPLETE supervision for the New York Public Service Commission over holding companies by amendment to existing law, in order to afford every safeguard against the profits of the operating company being cut down and going into the pockets of the stockholders of the holding company, is the outstanding recommendation of that commission made in its annual report to the New York State Legislature, presented last Monday. The commission recommends:

"1. That the Public Service Commission law be amended so as to permit inquiry into the costs and profit accruing to non-utilities from that branch of their business having to do with the furnishing of products or service to operating utilities for ultimate distribution to the consuming public.

"2. That the statute be amended so as to define as holding companies those corporations which control operating utilities in this state, not only by ownership of the majority of stocks, but also by lease or operating contract, with the right of appointing managers and employees, and by control through voting trustees.

"3. That the Public Service Commission law be amended to require holding companies controlling operating utilities to make and file annual and periodical reports on forms to be prescribed by the commission, including full details as to property, products or service exchanged between controlled companies and the revenues and expenses relating thereto.

"4. Giving jurisdiction and authority to the Public Service Commission to investigate the relationship between holding companies and operating utilities, to the end that all of the activities of the holding companies controlling operating companies in this state, including all contracts, agreements, etc., may be made a matter of public record."

As a basis for such recommendations the report of the commission says in part:

"Within the past few years, although there has been a great growth in the number of operating utilities and a tremendous increase in the popularity of utility securities as investments, many such issues, instead of being made by operating utilities themselves, are offered by the holding or finance companies, controlling through stock ownership, or as voting trustees, or by contract of management, etc., certain groups of operating utilities. While many holding or investment companies have long been supplying capital to operating utilities and have been of great benefit to the industry, yet the recent increase in the number of activities of holding and utility investment companies must mean that some of the controlling capital is being attracted by speculative possibilities. . . . Since the holding company is often not the operating company and the securities of the holding company are those being sold, it becomes possible that in-

vestors believe that they are purchasing the securities of local operating utilities which have received the sanction of the Public Service Commission. The situation is one which it seems necessary to correct by legislation."

The report of the commission also recommends legislation giving to it unquestioned power of regulation of electric sub-meters in large apartment houses, particularly those in New York City. "This problem," it says, "is becoming more and more acute, and frequent complaints are made to the commission alleging excessive charges. There is now no legal remedy. The constant increase in the number of apartment houses in which there are a large number of actual customers makes this problem one of major importance. Such customers frequently are billed at rates higher than those prevailing in the schedule of the electric corporation serving the initial customer. Such a means of distribution becomes also a source of profit for the property owner, whose interest in the accuracy of the meters may be negligible, if any."

The interconnection of transmission lines is commended, and an optimistic reference is made to rural service. Rural rates, the report says, have been devised which have for their basis a definite minimum charge which varies with the number of customers served over any extension. Investigation has revealed that there has been no waste of electrical energy in order to consume the maximum allowance as there has been careful selection of labor-saving devices adapted to farmers' use.

Tentative Radio Agreement Reached in Washington

A tentative agreement has been reached by the conferees of the Senate and House on the radio question. It has been decided to effect a compromise as between the Dill bill of the Senate, which provides for a radio commission, and the White bill of the House, which would give radio control to the Department of Commerce. In view of this reported agreement, the prospects are now considered favorable for legislation at this session, although in case of controversy on the floor of either house, the conference report may fail of adoption. Under the compromise, it is understood, a commission will be set up and have large powers, but they will be chiefly appellate and quasi-judicial. On the other hand, the Department of Commerce will have administrative powers.

Plan Power Development at Elephant Butte Dam

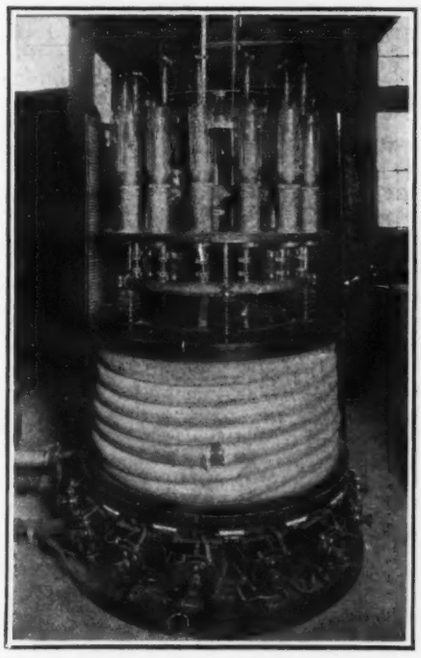
Encouragement is given the project of constructing a large hydro-electric plant in connection with the Elephant Butte Dam and irrigation enterprise in a message promising co-operation received by the El Paso Chamber of Commerce from the United States Reclamation Service. Two proposals are being considered. One is the development of power at the main dam which would be sold to the corporation at Las Cruces, N. M., at intermittent periods, and the other is the construction of a secondary dam which would furnish the corporation with continuous power. The latter enterprise would entail an expenditure of something like $2,600,000, and it is asserted that water users in the valley are going to move slowly in taking on big burdens which would add to the already existing agricultural loads.

L. M. Lawson, manager of the Elephant Butte project, asserts that all of the hydro-electric power plants which have been established at irrigation dams have been successes. One on the main canal in Yuma, Ariz., he says, yields a revenue of $40,000 a year. The two main features of power development which the government would watch are its relation to irrigation, which is paramount, and the question whether the investment of the water users would return a profit. "The government," Mr. Lawson declares, "investigated the project and reported that there was no engineering difficulty in the way and that the power development was economically sound."

Commercial Transatlantic Telephony

Successful Inauguration of Service Between United States and Great Britain Takes Place in Opening Week of Year—Complete Triumph Still to Come

ANOTHER milestone in engineering progress was set on Friday, Jan. 7, when transatlantic radio telephony on a commercial basis became a fact. The service, over a circuit of 850 miles of land line and 6,300 miles of ether path, was inaugurated a little before 9 o'clock in the morning by a conversation between Walter S. Gifford, president American Telephone & Telegraph Company, talking from the directors' room of the company in New York, and Sir G. Evelyn P. Murray, Secretary of the British Post Office, talking from London. Mr. Gifford was surrounded by about fifty officials of the telephone company and invited guests, who listened through headphones to the conversation. Among these participants were J. J. Carty, Bancroft Gherardi, F. B. Jewett, C. G. DuBois, E. S. Bloom, H. DeF. Arnold, C. P. Cooper and E. K. Hall, all prominent in Bell telephone or Western Electric affairs. Other conversations of public interest were held between Mayor Walker of New York and Lord Mayor Blades of London and between prominent newspaper men in the two cities. About twenty-five other calls were put through between 8.57 a.m. and 6.30 p.m., when the service was discontinued for the day. At one time St. Louis was connected over the telephone cable from New York to that city. On the following days there was a steady stream of messages, notwithstanding the high charge of $25 a minute, with a seventy-five-dollar minimum.



WATER-COOLED POWER-AMPLIFIER TUBES FOR TRANSATLANTIC SERVICE

For two long periods on the opening day no messages could be sent or received. The interference was much worse in sending from London than from this end, largely owing to the static arising at sunset. The English operators were forced to turn the system over to the technical men for readjustment and sometimes for the application of greater power. Conditions were said to be worse than they had been for a month previously, much to the disgust of the operators who estimated that rating normal freedom from static as 100 per cent, conditions were only 25 per cent favorable.

An outline of the research work which has led up to the transatlantic radio telephone was made by Mr. Gifford to those assembled in the directors' room. After tracing early efforts beginning in 1915, when words spoken in America were first heard in Paris and out into the Pacific as far as Honolulu, Mr. Gifford concluded:

"We are today employing about one hundred times the power that our apparatus of 1915 could handle and utilizing this power to many times as good advantage.

"The effectiveness of these developments was first illustrated publicly in a test of January, 1923, during which officials of our company, speaking in New York, were, by prearrangement, heard in London by a large gathering of engineers and scientists. The test continued for some four hours, and frequent cable replies stated that as different speakers came to our microphone not only their words but their voices as well were recognized by the listeners.

"Today our engineers are providing the novel arrangement of simultaneous transmission eastward on long waves

of 5,000 meters and short waves of 22 meters. These are both available to the receiving operator in London, who chooses whichever gives the better reception. Our short-wave transmission is directive, such as is sometimes called 'beam' transmission.

"Even with these alternate wave transmissions, however, the natural disturbances to which radio transmission is subject are sometimes too great for us. We cannot claim, therefore, that the problem of transoceanic telephony is entirely solved; but our efforts have reached such a stage that we believe progress can now most rapidly be made by having commercial use and further research studies go on together."

Revenue from Muscle Shoals

During the calendar year 1926 there was sold to the Alabama Power Company from the hydro-electric power plant at Wilson Dam a total of 428,265,885 kw.-hr. of electric power. The net operating revenue to the government from the Wilson Dam plant and the steam plant for the year ended Dec. 31, 1926, was as follows:

Receipts from sale of power, Wilson Dam	$872,617.47	
Maintenance and operation, Wilson Dam	173,777.53	
Net operating revenue, Wilson Dam		$698,839.94
Rental of steam plant under lease to Alabama Power Company	$120,000.00	
Receipts for power generated n steam plant	40,370.73	
Net revenue from steam plant		$160,370.73
Total net operating revenue Muscle Shoals plants		$859,210.67

Municipal Ownership Men Are Active at Olympia

Municipal power advocates announce their intention to take the offensive at this year's session of the Washington State Legislature, and the prospects are that there will be no strongly organized efforts to limit the existing powers of cities to operate power plants.

The Washington State Chamber of Commerce, which sponsored the Trunkey bill at the last legislative session, has dropped this measure from its program, leaders state. The Trunkey bill would have required any utility bond issue for a new unit on the Skagit or other project to be submitted to a separate popular vote. Mr. Trunkey was defeated in the primaries last fall, as was Mr. Cohen, another opponent of plans to spread public ownership.

Seattle councilmen at the last session refused to indorse the Jacobs bill, which was designed to give Tacoma a chance to sell its surplus power outside the city limits. Councilman Oliver T. Erickson sees a possibility that his "superpower" bill may be made the basis of legislative action. The Erickson bill would allow the creation of districts to build power plants, instead of confining this authority to cities. Then the various districts would be able to link their plants in a superpower system. Municipal power advocates generally agree that the state would be the proper unit for handling such a project, but the constitutional limit on state debt prevents.

Oppose Amending Law

Cabinet Members Forming Federal Power Commission Defend the Existing Practices

THE Secretaries of War, the Interior and Agriculture, constituting the Federal Power Commission, have reported adversely on the bill by Representative Garrett of Tennessee proposing to modify the existing definition of "navigable waters" and also affecting the requirements as to declarations of intention. "It is the opinion of the commission," say the Secretaries in their communication to the interstate and foreign commerce committee of the House, "that in all cases where federal authorization is necessary for power development in the streams of the United States such authorization should be given under the provisions of the federal water-power act, and that it would be a mistake to modify that act so as to withdraw from its provisions any prospective power developments, which if so withdrawn would require that authorization for their development be secured by special act of Congress or through action by the War Department under prior legislation."

In regard to the provision of the water-power act providing for the filing of declarations of intention the Secretaries say: "Since the provision now contained in the federal water-power act makes possible power development on streams of doubtful status under conditions which protect the interests of interstate and foreign commerce as well as those of the applicant, it is the opinion of the commission that the repeal of the provision, either outright or by indirection, would be a serious mistake. The expenditures involved in modern hydro-electric development are too large to permit of financing unless the right to continue use of the stream under known and fixed conditions is assured."

One of the provisions of the Garrett bill is that the water-power act is not to be construed or interpreted to authorize and empower the Federal Power Commision to "violate the sovereignty and property rights of the state" or the rights of riparian proprietors. The Secretaries say that the water-power act does not authorize the violation of the sovereignty and property rights which the states possess under the constitution. They point out that the act gives no authority to grant a license until the requirements of the state laws have been complied with.

During the hearings on the independent offices appropriation bill, which carries funds for the conduct of the Federal Power Commission, Representative Wood of Indiana made the point that it is deceptive to require the War, Interior and Agricultural Departments to use their money in the payment of salaries for the personnel of the Federal Power Commission. O. C. Merrill, the executive secretary of the commission, called attention to the fact that the commission has been unsuccessful in its efforts to secure an appropriation with which to pay its personnel directly.

Henry Ford and Governor Peay Talk on Cove Creek

Charging that the joint congressional committee on Muscle Shoals and Governor Peay of Tennessee plan to make a gift of $50,000,000 to the "power combine," Henry Ford, editorially, in the Dearborn (Mich.) *Independent* for Jan. 8, urges President Coolidge to block the scheme. "The real objective of the power combine at this time is the Cove Creek reservoir dam," the editorial states. "The power combine knows that the Cove Creek reservoir dam is worth $50,000,000 and perhaps $100,000,000, and the combine knows that this dam belongs to the people of Tennessee, yet the combine asks the Federal Power Commission to make a gift to them of Cove Creek and Governor Peay approves."

Declaring Mr. Ford's statement "all nonsense," Governor Peay said in reply: "I am particularly desirous of having development of this power supply start immediately, and I am including in my message to the Legislature a request that an opinion on the Cove Creek reservoir dam be handed down by the Attorney-General. Should it develop that the Cove Creek dam actually does belong to the people of Tennessee, then we shall consider legislation for its disposition. My belief, however, is that it comes under the federal statute."

Virginia Electric's 30-Month Budget $20,000,000

William E. Wood, vice-president Virginia Electric & Power Company, in a review of 1926 and forecast for this year, says that from July 1, 1925, when Stone & Webster took charge of this property to the end of the present year, expenditures for acquisitions, extensions, improvements and betterments will cost approximately $20,000,000. This sum covers in work already accomplished or now under way the installation of a 40,000-hp. steam turbo-generator at Norfolk, addition of a hydro-electric unit at Fredericksburg, the doubling of the generating capacity at Williamsburg, acquisition of a small steam generating station at Tarboro, N. C., and building of a 1,200-hp. hydro plant on the James River in South Richmond and of a small plant in Tappahannock.

In addition, three 110-kv. transmission lines—from Suffolk, Va., to Roanoke Rapids, N. C.; from Roanoke Rapids south to Scotland Neck, and from Suffolk south to Elizabeth City, N. C.—have been built as well as a 66-kv. line north from Richmond to Fredericksburg and other smaller lines. As a result, Mr. Wood says, tidewater Virginia and northeastern North Carolina now possess "one of the major superpower systems of the country, which is stabilized and augmented with adjoining superpower systems in North Carolina and Virginia."

Rush for Revillagigedo

Six Newsprint Makers Have Eyes on Site in Alaska—Great Dam Projected for Glen Canyon

THE International Paper Company of New York has applied to the Federal Power Commission for a preliminary permit for a power development on Revillagigedo Island, Alaska. This application conflicts with those previously filed by William Randolph Hearst, Mark L. Requa, George T. Cameron, Thebo, Star & Anderton and the Alaska Pulp & Paper Company. Apparently the newspapers and the newsprint interests represented by the applications have concluded that conditions are particularly favorable on Revillagigedo Island for the manufacture of paper and pulp. Since the applicants first must obtain a timber license from the Forest Service, the conflict will be settled before that agency rather than before the Federal Power Commission. The commission probably would grant the power license to the interest holding the timber rights.

The Board of Directors of State Institutions of Arizona has applied to the Federal Power Commission for a second site on the Colorado River. The first application for preliminary permit covered the site at Bridge Canyon. The more recent application covers the Glen Canyon site. This latter project proposes the construction of a rock-fill or gravity-type dam at a point 4 miles above Lee's Ferry. It would be 693 ft. in height and would have a reservoir capacity of 50,501,260 acre-ft. The dam would back up water for 205 miles to a point near the mouth of Green River in Utah. It is stated that the water will be used in connection with the Bridge Canyon project and also for irrigation in connection with the Arizona "high-line" reclamation project.

Failure of the Public Service Commission of Oklahoma to co-operate with the Federal Power Commission may result in years of delay in the development of the power resources of Grand River in that state. On July 6, 1925, the Federal Power Commission approved the application of the Public Service Company, a privately owned concern, covering a power site on the river. This application will not expire until July 6, 1928. After this preliminary permit had been granted the Public Service Commission of Oklahoma gave the state rights to J. E. Robinson of Miami. Unless an agreement can be reached between the applicants it would be possible to delay the project until July 6, 1928, and even then the Federal commission's permittee could apply for a license and delay matters further by insisting upon the consideration of that application.

The Northern Connecticut Power Company of Thompsonville, Conn., has applied to the Federal Power Commission for a license covering a project on the Connecticut River in Hartford County, Conn., and Hampden County, Mass. The applicant proposes to construct a dam 1,150 ft. long in the east channel and a dam 500 ft. long in the west channel of the river. The former dam will be 17 ft. high and the latter 23 ft. high. It is proposed to install ultimately six units of 8,300 hp. each. The application covers the same project as that filed by the Connecticut River Company, but the preliminary permit issued to that company has expired. In the meantime the Connecticut River Company has been absorbed by the Northern Connecticut Power Company. The development is commonly known as the Windsor Locks project.

The city of Colorado Springs, Colo., has applied to the commission for a license covering its constructed project on Ruxton Creek and its tributaries. The primary purpose of the project is municipal water supply, to which the development of power is incidental. The present installation is 4,300 hp.

Joseph Wittman of New York has applied for a preliminary permit covering a power project on Kirkland Creek and on the Santa Maria and Bill Williams Rivers in Arizona. The applicant proposes to construct a storage reservoir on Kirkland Creek and a diversion dam in Bill Williams River. Plans call for five power houses. No estimate is made of the power capacity of the project.

Canada Installed 266,000 Hp. in 1926

Previous Completion of Large Enterprises Makes Figure Fall Below That for 1925, but Investment of $25,000,000 Was Represented—Big Projects Under Way

DURING the year just closed 266,000 hp. of electrical energy was added to the water-power development of Canada, the total installation now amounting to 4,556,000 hp. The new development represents a direct investment of at least $25,000,000. These figures are contained in the annual report of the Water Power Branch of the Dominion government. The report further states:

"New hydro-electric enterprises require several years to progress from the prospect stage to the actual production of power, but after the completion of an initial development until the final capacity of the site is reached the same station continues to record increases as new units are added. The record installation of 1925 was, in a considerable measure, made up by bringing existing stations up to capacity, and it was therefore inevitable that the new units added during 1926 should reach a more modest total; nevertheless 1926 was, even more than 1925, a banner year in hydro-electric enterprise. Projects were actually under way which will ultimately add 1,700,000 hp. to the total development, while three plants composing a single enterprise will alone have a capacity double that of the entire new installation during 1926. Of these three plants two are nearly completed.

"In addition to the projects actually under construction others involving a further 1,000,000 hp. are in active prospect, so that we may expect a direct investment of $270,000,000 at least in Canada's hydro-electric industry during the next few years, with a further and much larger investment in industries and equipment for the distribution and utilization of this new power.

"The outstanding activities during 1926 occurred in the Province of Quebec, although some of the greatest of these are not reflected in the total of new installations, as they did not reach the production stage. In British Columbia and Manitoba noteworthy advance was made, while in the remaining provinces progress was made with promising projects.

"In Quebec 168,000 hp. was installed, 90,000 hp. of which, in the Ile Maligne station of the Duke-Price Power Company on the Saguenay River, brings the installation there from 360,000 hp. to 450,000 hp., the ultimate capacity being 540,000 hp. Of the remaining installations may be mentioned the replacement of a 1,600-hp. development by one of 22,000 hp. on the Batiscan River by the Shawinigan interests and a 16,000-hp. addition at the Kippewa plant of the Canadian International Paper Company. The same company is also responsible, through its subsidiary, the Gatineau Power Company, for the greatest hydro-electric activity during the year, two plants on the Gatineau River, one at Chelsea of 170,000 hp. and one at Farmers Rapids of 120,000 hp. being nearly completed, while a third, of 240,000 hp., at Paugan Falls was begun.

"Progress was also made on another and larger development, that of the Aluminum Company of Canada at Chute-à-Caron on the Saguenay River, where a development of 800,000 hp. ultimate capacity is in course of construction. This company is already operating its reduction works at the new town of Arvida with power from Ile Maligne. The Ontario Paper Company commenced the construction of a 40,000-hp. station on the Outardes River."

There was a lull in hydro-electric development in Ontario last year due to the previous completion of a heavy construction program, the principal units of which were the Queenstown-Chippawa plant at Niagara and the Cameron Falls plant on the Nipigon River. These two stations of the Ontario Hydro-Electric Power Commission, with 550,000 hp. and 75,000 hp. capacity respectively, were completed in 1925.

The outstanding developments in British Columbia in 1926 were those carried out by the West Kootenay Light & Power Company and the British Columbia Electric Railway. The former completed one program of development by adding a third unit of 20,000 hp. to its Lower Bonnington Falls plant, bringing the capacity to 60,000 hp. This company intends soon to begin work on a new development of 60,000 hp. at South Slocan. The British Columbia Electric Railway Company

carried out considerable work on its 12,500-hp. Allouette power station. A major development at Bridge River, calling for an initial capacity of 54,000 hp. and which may exentually reach from 500,000 hp. to 700,000 hp., will be actively under construction before long.

In Manitoba the Winnipeg Electric Company, through its subsidiary, the Manitoba Power Company, brought in its third unit at the Great Falls plant. A contract for the fourth unit of 28,000 hp. has been let, and the job will be completed, it is planned, in 1927.

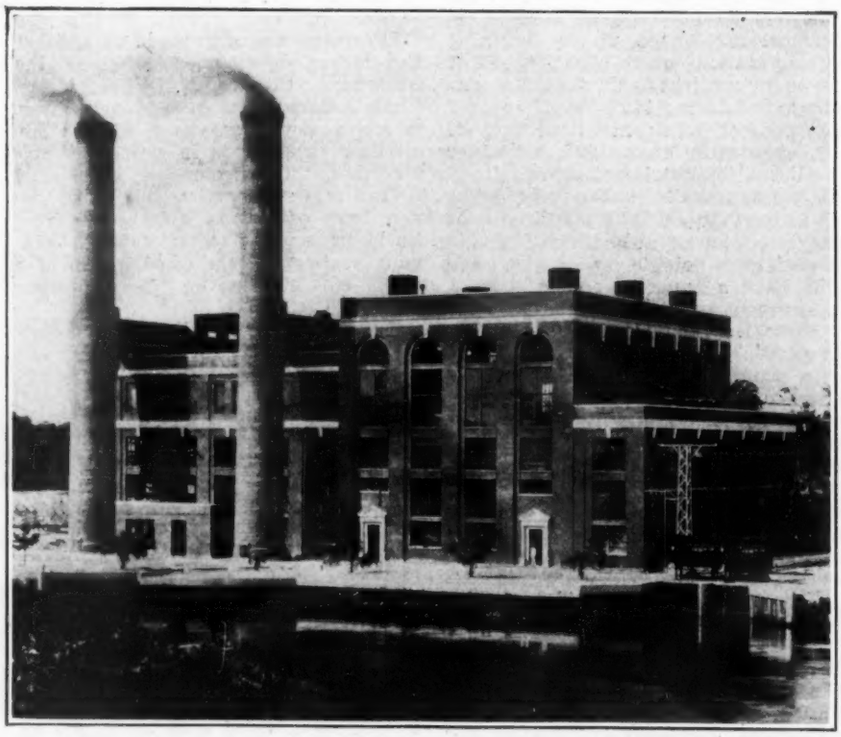
Carillon Power Sought

Renewal of Lease of Hydro Site on Ottawa River Is Asked of Dominion Parliament

THE eastern Ontario power situation may provide a highly controversial subject during the forthcoming session of the Canadian Parliament, according to an ELECTRICAL WORLD representative at Ottawa. There are several angles to the question, and the fact that Premier King himself is likely to assume the office of chairman of the national advisory council dealing with the St. Lawrence project is an indication of the importance attached to it by the government. This year there will be another request for a renewal of the lease of water rights at Carillon, on the Ottawa River, for the National Hydro-Electric Company. C. A. Magrath, chairman of the Ontario Hydro-Electric Power Commission, says that the commission is waiting to receive any proposals that may be made in connection with this site. Engineering data have all been completed, he says.

The withdrawal of a resolution calling for the development by the Ontario commission of power at Morrisburg, on the St. Lawrence, is taken to mean that the commission is persuaded there is little possibility of Canada uniting with the United States in the St. Lawrence project for a good many years. In the meantime the commission is obliged to look elsewhere for water power in eastern Ontario to meet its rapidly increasing demands. It is believed that the disposition of the Carillon project will be largely, if not wholly, determined by the attitude of the federal government toward a further extension of the charter of the Georgian Bay Canal, and that there may develop a five-sided clash between the interests of the Georgian Bay Canal promoters, the National Hydro-Electric Company, the Quebec government (which is alert to the maintenance of its power rights on the Ottawa River), the Ontario Hydro-Electric Power Commission and the federal government. It is a current opinion that while the Ottawa River controversy is not directly related to the wider and international question presented by the report of the Joint Engineering Board on the St. Lawrence power project, it will undoubtedly tend to retard progress in any negotiations between the governments of Canada and the United States.

Florida's Latest Central Station Goes in at Inglis



FLORIDA now has another central-station plant with an ultimate rating of considerable size. This is the steam-electric plant of the General Engineering & Management Association at Inglis, on the Withlacoochee River, which will have a capacity of 25,000 kw. The first 6,000-kw. unit has just gone into commission. The ELECTRICAL WORLD on Aug. 21 last described this plant and alluded to the difficulties of construction due to its remote site.

Briefer News

New Franchise for St. Louis Central-Station Company.—The Union Electric Light & Power Company of St. Louis has obtained a franchise to furnish Fredericktown, Mo., with light and power. The company has just completed a 54-mile transmission line from Festus to Mine Lamotte to serve towns in that section of the state, including Bonne Terre, Flat River, Desloge and Farmington.

Oregon Public Service Commission Plans Valuations. — In planning its activities for the ensuing year the Public Service Commission of Oregon is giving special regard to valuations of electric light and power utilities and will direct its engineering department to determine new valuations or bring up to date the incomplete valuations of the Enterprise Electric Company, Vernonia Light & Power Company, Jensen Light & Power Company of Lakeview, Prairie Light & Power Company of Prairie City, Northwestern Electric Company of Portland and the People's West Coast Hydro-Electric Corporation of Portland.

Rebuilding of Big Meadows Dam Finished.—The work of enlarging the Big Meadows Dam of the Great Western Power Company in California has been completed, and the run-off from the company's 500-square mile watershed in Plumas County will be stored in Lake Almanor this winter, according to a statement issued recently by W. G. B. Euler, general superintendent. Enlargement of this massive structure was accomplished in 21 months at a cost of $2,000,000. It increases the capacity of Lake Almanor from 300,000 acre-feet to 1,300,000 acre-feet. (See ELECTRICAL WORLD for Oct. 23, 1926, page 873.)

Maine Lesislature to Take up St. John River Project.—A measure to provide for the storage of water on the upper reaches of the St. John River in connection with the power development now going forward at Grand Falls, in the Province of New Brunswick, is likely to be introduced into the Maine Legislature at the present session. Maine is by international agreement to receive 2,000 hp. of Grand Falls energy at the same rates as will be paid by dwellers in New Brunswick. The projected storage will have a bearing both on paper-manufacturing enterprises and the Gould railroad planned between Aroostook County and the Quebec boundary.

Nebraska Electric Companies Eschew Politics.—Representatives of light and power companies doing business in Nebraska held a meeting recently in Omaha and, after discussing the situation in the state, decided that no legislation of any character affecting the industry would be suggested or asked at the legislative session which began Jan. 4. The companies have had under consideration several matters upon

which they were agreed legislative action was desirable, but because of the stirring up in recent months of public prejudices based on talk about "superpower" it was decided that activities at the Capitol in Lincoln would be confined to defensive action, if such prove necessary, and to answering freely all questions asked about the industry.

Transmission Line to Mobile and Pensacola in Service.—The 110-kv. wooden-pole transmission line of the Alabama Power Company from Lock 18 to Mobile and Pensacola (see ELECTRICAL WORLD for Oct. 16, page 797) was placed in service during December. Energy from this line was first used in Pensacola on Dec. 5 (as recorded recently), in Mobile on Dec. 19 and in Flomaton on Dec. 20. The line from Lock 18 to Flomaton and Mobile is of 397,500-circ.mil aluminum core, steel-reinforced, the distances being 131.1 miles (Lock 18 to Flomaton) and 67.89 miles (Flomaton to Mobile) respectively. From Flomaton to Pensacola No. 4/0 wire is used, the distance being 39.34 miles. Substations have been built at all three points, their capacities being 4,500 kva. at Flomaton, 6,000 kva. at Pensacola and 14,300 kva. at Mobile.

Threats of Competition in Maryland.—Havre de Grace, Md., is a bone of contention between the Northern Maryland Power Company, which now serves it, though its franchise has expired, and the Consolidated Gas, Electric Light & Power Company of Baltimore, which is said to claim the right to do so if it should so decide. The City Council of Havre de Grace has ordered the first-named company to discontinue service, but the Public Service Commission has granted the company until Feb. 1 to build a line to Earlton, near Havre de Grace, over a route for which the larger company desires a permit. Assertions by officials of the Northern Maryland Power that if its rival goes to Havre de Grace it in turn will extend its lines to Baltimore are quoted by the newspapers. Both companies must, however, be guided by the commission's interpretation of what constitutes invasion of territory.

Program of Empire State Association's Electric Section.—Vice-president Lieb of the New York Edison Company will welcome the delegates to the annual meeting of the Electric Section of the Empire State Gas and Electric Association when they assemble at the company's West Twenty-seventh Street substation on Jan. 21. Reports will be given by the apparatus committee, the operation committee, the underground systems committee, the overhead distribution committee and the tree-trimming committee. C. H. Churchill, Jr., chairman of the farm electrification research council, will speak on the reliability of appliances connected to the service from rural lines. On Saturday, Jan. 22, Alfred E. Waller, managing director of the National Electrical Manufacturers' Association, will address the convention, and there will be reports from the transmission-line, hydraulic-power and radio-interference committees, as well as an address on the Wallenpaupack 220-kv. system.

Utica Company's New Transformer Station.—Construction work on the new 30,000-kva. transformer substation of the Utica Gas & Electric Company about two miles north of Deerfield Corners, N. Y., is almost complete. All of the 110,000-volt power lines centering at this point have been cut in. This substation plays an important part in the Mohawk-Hudson Power Corporation system on account of being the focus of lines from the west, north and east. Niagara, Lockport & Ontario power comes in over the western line, Northern New York Utilities power comes from the north, and power from the Adirondack Power & Light Corporation reaches the station from the east. The lines of the Utica Gas & Electric Company from Trenton Falls and Harbor Point also come in. The station steps voltage down from 110,000 to 44,000 or up in reverse manner. Carrier-current equipment for communication is installed.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations, with their secretaries, is published in the first issue of each volume. For latest list see ELECTRICAL WORLD, Jan. 1, page 80.]

Northwest Association of Electrical Inspectors—Multnomah Hotel, Portland, Ore., Jan. 17 and 18. F. D. Weber, Box 745, Portland.

National Electrical Manufacturers' Association (Supply Division)—New York, Jan. 17-21. S. N. Clarkson, 30 East 42d St., New York.

National Electric Credit Association—New England Division, Boston, Jan. 18. F. P. Vose, 1008 Marquette Bldg., Chicago.

Empire State Gas and Electric Association, Electric Section—New York Edison Auditorium, 44 West 27th St., New York, Jan. 21 and 22. C. H. B. Chapin, Grand Central Terminal, New York.

Western Association of Electrical Inspectors—Kansas City, Mo., Jan. 25-27. W. S. Boyd, 175 West Jackson Blvd., Chicago.

Electrical Supply Jobbers' Association, Pacific Division—Del Monte, Cal., Jan. 27-29. F. Overbagh, 411 South Clinton St., Chicago.

National Association of Lighting Equipment Dealers—Hollenden Hotel, Cleveland, Jan. 31-Feb. 5. G. P. Rogers, 424 Guarantee Title Bldg., Cleveland.

Northwest Electric Light and Power Association, Commercial Section—Multnomah Hotel, Portland, Ore., Feb. 10 and 11. L. A. Lewis, Washington Water Power Company, Spokane, Wash.

American Institute of Electrical Engineers—Midwinter convention, New York, Feb. 7-10; Southwestern District, Kansas City, March 17-18; Middle Eastern, Bethlehem, Pa., April 14-16. F. L. Hutchinson, 36 West 39th St., New York.

Kentucky Association of Public Utilities—Brown Hotel, Louisville, Feb. 18 and 19. E. F. Kelley, Louisville Railway Co., Louisville.

Oklahoma Utilities Association—Huckins Hotel, Oklahoma City, March 8-10. E. F. McKay, 307 Local Building, Oklahoma City.

Southeastern Division, N.E.L.A.—Peabody Hotel, Memphis, Tenn., April 13-15. C. M. Kilian, 404 Wynn-Claughton Bldg., Atlanta.

Southwestern Division, N. E. L. A.—New Orleans, April 26-29. S. J. Ballinger, San Antonio Public Service Company, San Antonio, Tex.

Southwestern Public Service Association—New Orleans, April 26-29. E. N. Willis, 403 Slaughter Bldg., Dallas, Tex.

Nebraska Section, N. E. L. A.—Grand Island, Neb., April 27-28. H. M. Davis, 1519 O St., Lincoln.

Green Bay's New Unit to Be Held in Reserve.—Completion and test operation of the first of two 10,000-kw. turbo-generators is reported by the Wisconsin Public Service Corporation in connection with the construction of its Bay Side steam plant at Green Bay, at a cost of $2,500,000. This plant is not yet needed, and for the present the new unit will represent reserve capacity.

Northern States Power Has Seven-Million-Dollar Budget. — Besides approximately $1,000,000 for work on the projected 24,000-hp. hydro-electric plant at Chippewa Falls, Wis., already noted, the 1927 budget of the Northern States Power Company calls for an expenditure of more than $6,000,000 in Minneapolis, St. Paul and other points in Minnesota and in Wisconsin, Illinois, Iowa and North and South Dakota, most of which is electrical in its nature. Capacities of the Riverside steam plant at Minneapolis and the High Bridge station at St. Paul are to be increased, the former by 7,500 kw. About 1,500 kw. will be added to the Fargo (N. D.) station by converting it into a full condensing plant. Ratings of eight substations in the Twin Cities will be substantially increased, four being in Minneapolis and four in St. Paul, and additional distribution facilities will be provided. The substation at Mankato, Minn., will be rebuilt, as will 160 miles of transmission lines. Sioux Falls, S. D.; Grand Forks, N. D., and Galena, Ill., are other places where expansion is planned.

Southern California Edison to Spend $42,000,000 in 1927. — Expenditures totaling $42,000,000 are planned by the Southern California Edison Company for the ensuing year, according to a statement issued by R. H. Ballard, executive vice-president and general manager. This sum includes the new 100,000-kw. unit for Long Beach noted last week (page 115). Work on the fifth power plant of the Big Creek-San Joaquin series in the High Sierras is also to be started, and the northern end of the Vincent transmission line will be pushed to connect near Bakersfield with the southern end, which went into service in November. The new Big Creek plant will have a rating of 112,000 hp., and it is planned to finish the power house and the transmission line together early next year. The appropriation for these is $15,000,000, which is a larger sum than has ever previously been set aside for one year's work on Big Creek. In addition, 75 substations will be built new or will have their capacities materially increased during the coming year. These substations and the lines distributing power from them will help to account for the $16,000,000 to be spent for additions and miscellaneous betterment throughout the entire system.

Men of the Industry

H. M. Atkinson Takes Year's Leave of Absence

Harry M. Atkinson, chairman of the board of directors of the Georgia Railway & Power Company, Atlanta, has taken a year's leave of absence from his duties to aid in leading the farmers of Georgia to a financially and economically sound agricultural basis. Mr. Atkinson has been interested in agricultural work for some years. For 40 years a leader in Georgia's industrial development, Mr. Atkinson recently decided that he could render a greater service during 1927 by turning his aggressive efforts into the agricultural field and accepted the chairmanship of the advisory committee of the Georgia association on the invitation of President Hastings.

For many years Mr. Atkinson has

H. M. ATKINSON

been a leader both in financial and public utility circles in the South. He has been identified with all the important electrical undertakings in Atlanta for 30 years, having organized and built the first electric lighting system in Atlanta and also the Atlanta, Birmingham & Atlantic Railroad. He was the first president of the Georgia Electric Light Company and was an important factor in the consolidation of the City Railways & Lighting Companies of Atlanta into the Georgia Railway & Electric Company. He also organized the Georgia Railway & Power Company, which subsequently leased the Georgia Railway & Electric Company. Mr. Atkinson will remain as board chairman of the utility, serving especially in an advisory capacity, so that he can give additional attention to civic interests.

Gustaf W. Elmen, electrical engineer in the Bell Telephone Laboratories, New York, has been made the recipient of the John Scott medal for the invention of the nickel-iron alloy known as permalloy. The medal will be presented to Mr. Elmen during the coming winter convention of the American Institute of Electrical Engineers. Though born in Sweden, Mr. Elmen was educated at the University of Nebraska and following graduation he entered the employ of the General Electric Company, with which he remained for two years. After spending nineteen years with the Western Electric Company he affiliated himself with the Bell Telephone Laboratories. Mr. Elmen is a member of the A.I.E.E.

Edward Caldwell Resigns

Edward Caldwell has resigned from the presidency of the McGraw-Hill Book Company, Inc., New York City, and will retire from active business. Mr. Caldwell has been associated with the McGraw-Hill interests for 36 years. He was one of the organizers of the McGraw-Hill Book Company in 1909 and has been active in its management since its formation. Mr. Caldwell will remain on the boards of directors of the McGraw-Hill Book Company and the McGraw-Hill Publishing Company, Inc. Martin M. Foss, who was associated with Mr. Caldwell in the organization of the McGraw-Hill Book Company, has been chosen to succeed Mr. Caldwell as president.

In honor of Mr. Caldwell the McGraw-Hill Book Company tendered him a dinner at the Engineers' Club, New York, on Friday, Jan. 7, at which about 150 of his associates and friends assembled. Mr. Foss was toastmaster, and speeches were made by James H. McGraw, president McGraw-Hill Publishing Company; Dr. John H. Finley, of the New York *Times;* James H. Thompson, head of the educational department of the book company; Curtis W. McGraw, its treasurer, and Dr. H. C. Parmelee, editor *Chemical and Metallurgical Engineering.* Mr. Caldwell's great success in building up the book company, his extraordinary capacity for work, his sterling character and engaging personal qualities were dwelt upon by the speakers, who wished him joy in the journeys and the pursuit of his hobbies to which he is looking forward. A sterling silver bowl was presented to him.

Charles Day Heads Board

Charles Day, formerly president of Day & Zimmermann, Inc., Philadelphia, has been made chairman of the board of directors, and John E. Zimmermann, who has been a vice-president, has become president to succeed Mr. Day. Floyd W. Woodcock has been placed in charge of public utility management and E. M. Chance in charge of engineering and construction. W. Findlay Brown has been given charge of engineering reports and valuation work covering industrials and utilities.

Dr. Walton Clark, consulting engineer of the United Gas Improvement Company, Philadelphia, was presented with the Walton Clark medal, endowed by the U. G. I., on Dec. 22 in the Franklin Institute. Dr. Clark was president of the Franklin Institute for seventeen years and was formerly a vice-president of the United Gas Improvement Company. The presentation was made by W. C. L. Eglin, president of the Franklin Institute and vice-president of the Philadelphia Electric Company.

W. H. Taylor New Vice-President of U. G. I.

William H. Taylor, vice-president and general manager of the Georgia Railway & Power Company, Atlanta, has resigned his position to become vice-president in charge of operations of the United Gas Improvement Company of Philadelphia.

Mr. Taylor was born in Wilkes-Barre, Pa., in 1880 and attended the Stevens Institute of Technology, being graduated as an engineer in 1902. One year after his graduation he began his active career as a constructor with the U. G. I. forces, rising step by step through the engineering, management and construction departments to the position of vice-president and general manager for the outlying districts.

Five years ago Mr. Taylor removed his interests to Atlanta as executive

W. H. TAYLOR

assistant to the president, later to become vice-president and general manager of the Georgia Railway & Power Company. Prior to joining the staff of that company Mr. Taylor was president of the Omaha Gas Company, a U. G. I. property, and had served as operating head of U. G. I. properties in Gloversville, N. Y., and Charleston, S. C. He has played a conspicuous part in the appraisal of public utility properties and has frequently appeared as an expert before public service commissions and federal courts as an authority on rates and service. He will assume his new duties Feb. 1.

A. Emory Wishon and **J. B. Black** will be the guests of honor at a luncheon of the San Francisco Electrical Development League on Jan. 17. Mr. Wishon, vice-president and general manager of the San Joaquin Light & Power Corporation, was recently made vice-president and general manager of the Great Western Power Company as well, succeeding J. B. Black, who has been appointed vice-president of the North American Company.

Frank D. Paine, recently assistant director of the National Committee on the Relation of Electricity to Agriculture, has returned to Iowa State College following the completion of the

year's leave of absence during which he was associated with the national committee. Professor Paine will resume his position as professor in the electrical engineering department and electrical engineer for the engineering experiment station. During the year Mr. Paine worked out and put into effect an organized plan of co-operation between the manufacturers of electrical equipment and farm machinery and the 21 state projects on rural electrification. Supervision of the Iowa project on rural electrification will become one of the principal duties of Mr. Paine.

E. C. Easter, formerly associate professor in the agricultural department, Alabama Polytechnic Institute, Auburn, Ala., became associated with the Alabama Power Company Jan. 1 as agricultural engineer. Mr. Easter will co-operate with the farmers of Alabama in solving electrification problems. He has had wide experience in this work, particularly for the last three years, during which he has had charge of all field work of the agricultural engineering department at Auburn. In promoting rural electrification this department has had the close co-operation of the Alabama Power Company. Mr. Easter will make his headquarters temporarily at Auburn, keeping in close touch with the agricultural engineering department as it continues its research work.

William J. Wuestenfeld, general manager of the Ottumwa (Iowa) Gas Company, will be transferred to Davenport, Iowa, about Feb. 1 as successor to C. R. Stahl, assistant general manager of the People's Light Company. Mr. Stahl was recently advanced to head of the United Light's new properties in the Panhandle district in Texas.

Obituary

Galen L. Stone, a leading Boston banker and director in public utilities, died at Boston Dec. 26.

Erich Buehle, hydraulic turbine designer of the Pelton Water Wheel Company, died Dec. 12 at San Francisco, at the age of 41. He came to this country in 1906 from Germany, where he had been employed with the I. M. Voith Company on hydraulic design. He had been with the Pelton Water Wheel Company for 20 years.

Louis Lewis, electrical engineer, died in Jefferson Hospital, Philadelphia, Dec. 28 in his seventy-eighth year. Mr. Lewis was one of the South's pioneer electrical engineers, having planned and installed in Richmond, Va., the first electric street railway owned by the Virginia Light & Power Company. He also designed and built the electric power equipment in many large mills and institutions.

John W. Hallowell, formerly a member of the firm of Stone & Webster, Boston, died in that city on Jan. 5 after a short illness. He was 48 years of age and was president of the Associated Harvard Clubs. Mr. Hallowell resigned from the Stone & Webster firm during the war period to engage in various kinds of public service.

Charles Page of Sand Springs, Okla., died at his home in that city Dec. 27 after an illness of two weeks. Mr. Page founded a large number of industries in Sand Springs and also organized the Sand Springs Power, Light & Water Company and the Sand Springs Railway Company. He was born at Stevens Point, Wis., but after engaging in railroading, real estate and mining, he removed his interests in 1902 to Oklahoma.

Leo Lustig, engineer of Prague, Czechoslovakia, died recently after several months' illness. Mr. Lustig was born in Bohemia and received there both his high school and his technical training. In 1907 he came to the United States, affiliating himself with the General Electric Company. Later he entered the switch department of the Westinghouse Electric & Manufacturing Company and subsequently spent some time in Cuba before returning to his native country. Mr. Lustig was a member of the American Institute of Electrical Engineers and of the Czechoslovakia Electrical Institute.

John W. Alling, head of Alling, Webb & Morehouse, one of the oldest law firms in Connecticut and prominently identified with several public utility companies in that state, died Jan. 9 at his residence in New Haven after a four months' illness. Mr. Alling was one of the oldest alumni of Yale University and a former president of the Security Insurance Company and of the Southern New England Telephone Company. He was an organizer and a director of the United Illuminating Company, the Connecticut Railway & Lighting Company and the Merchants' National Bank of New Haven.

Charles Frederick Brooker, an outstanding figure in the copper-manufacturing industry of the United States and for more than 50 years a leader in the Republican party of Connecticut, died Dec. 20 at Daytona Beach, Fla., in his seventy-ninth year. A native of Litchfield, Conn., he became identified with the metal-working industry when only seventeen years of age. For twenty years he was president of the American Brass Company, retiring in 1920 to become chairman of the board. Perhaps his greatest business achievement was the consolidation of a number of brass-manufacturing companies into the American Brass Company. Although always actively engaged in conducting his business, Mr. Brooker found time to take a leading part in Republican affairs in Connecticut from early manhood.

Edward D. Densmore, for many years a partner in the engineering firm of Densmore, Le Clear & Robbins, Boston, died at his residence in Brookline Dec. 25. He was born in Somerville, Mass., 55 years ago and was educated at the Massachusetts Institute of Technology and Harvard University. In 1899 he entered into partnership with Gifford Le Clear, establishing the firm bearing their names, and was identified with the engineering and architectural problems involved in the erection of many important buildings in the Boston district and elsewhere, including the Harvard Medical School, Park Square Building, Boston, and other institutional and business structures.

Gaston Sciama, the general director of the Maison Breguet, Paris, France, died Nov. 24. Mr. Sciama had been associated with the firm since 1884 and was an ex-president of the Société Internationale des Electriciens.

Charles A. E. Carr, dealer in railway supplies in Toronto, Ontario, and formerly manager of the Helena (Mont.) Light, Heat & Power Company, died in Toronto on Dec. 30, following an operation. Mr. Carr was born in Thornton, Ontario, 56 years ago. For some years he was manager of the London (Ontario) Street Railway Company. He had also managed similar enterprises in Quebec and New Orleans.

Joseph H. Procter, patent attorney for the Westinghouse Electric & Manufacturing Company, East Pittsburgh, died Nov. 1. A native of Houston, Tex., Mr. Procter received the B. S. degree from the Agricultural and Mechanical College of Texas in 1910, the E. E. degree in 1913, and after studying law from 1915 to 1918 he was admitted to the bar of Pennsylvania. From 1910 to 1912 he was occupied as an engineering apprentice of the Westinghouse Electric & Manufacturing Company in the test and design of transformers and induction motors, then becoming instructor of electrical engineering at his Alma Mater. It was in 1913 that he affiliated himself with the Westinghouse interests as patent attorney. In that capacity he specialized in electrical inventions for company developments up to the time of his death.

Edward B. Ellicott, prominent engineer and one of Chicago's leading citizens, died Oct. 26 following an operation. Colonel Ellicott entered upon his professional career as an engineer in 1886 as an employee of the Salina (Kan.) Gas & Electric Company. The next year he transferred his interests to Concordia, Kan., where in 1888 he became superintendent of the Concordia Electric Light Company. It was in 1891 that he affiliated himself with the Western Electric Company in Chicago as installation expert on lighting plants, from which position he advanced to that of assistant superintendent and subsequently superintendent of construction. The city of Chicago made him city electrician in 1897, and he remained in that office for eight years. In 1904 he was made chief mechanical and electrical engineer of the Louisiana Purchase Exposition in St. Louis, and the following year he became chief electrical engineer of the Sanitary District of Chicago, a position he held until 1916, when he established his own consulting engineering practice. Colonel Ellicott served as president of the Board of Education of Chicago for about a year and a half and engaged with distinction in the World War, the source of his military title. He was a fellow of the American Institute of Electrical Engineers and a member of the American Society of Mechanical Engineers and of the Western Society of Engineers.

Commission Rulings

Fulfillment of Twelve-Month Period of Rate Agreement Insisted Upon.—The Massachusetts Department of Public Utilities has dismissed without prejudice a petition of customers of the Cape & Vineyard Electric Company for a reduction in rates. At the time the rates were approved representatives of the company and of the towns served by it agreed that a year's trial of the new schedules should be given in order to enable the commission to determine whether the rates yield a fair return to the company and are equitably distributed between seasonal and year-round customers. The rates are of the compound type with an area and energy charge involved. The year ends April 1, 1927.

Absorption of Remote Utility Not in the Public Interest.—The New York Public Service Commission has denied an application by the Genesee Valley Gas Company, Inc., for permission to acquire all the outstanding capital stock of the Ticonderoga Electric Light & Power Company. "It is true," the finding says, "that the commission has granted a number of petitions which had for their purpose the expansion of existing systems and better co-ordination of different operating entities. In all these cases the properties acquired have either formed a logical unit or have extended such units. The present proposal does not come within this class of cases. The Ticonderoga Electric Light & Power Company is remote from the other properties in which the petitioner is interested, and the only consideration seems to be the one of financial investment. We do not see how the public interest is to be served thereby."

Division of Territory to Eliminate Fear of Competition.—The Jersey Central Power & Light Corporation and the Eastern New Jersey Power Company serve indiscriminately private consumers throughout the borough of Spring Lake, the Eastern New Jersey Power Company also furnishing street lighting to the northern portion of the borough, while the Jersey Central Power & Light Company serves mainly the southern portion. The contracts for street-lighting service by both companies in the borough have expired, and the Jersey Central Power & Light Company filed a petition with the New Jersey Board of Public Utility Commissioners requesting the board to determine the territory to be served by street lighting by both companies and that the Eastern New Jersey Power Company be enjoined from attempting to furnish street lighting in that portion of the borough now served by the petitioner. The board held that the theory of competition is not consistent with regulation and that any contract that might be made as a result of competitive bidding would, if found unduly preferential or discriminatory, be set aside by the board in a rate case. The board found also that inasmuch as the development of the street-lighting service has been substantially divided between the companies, one serving the northerly and the other the southerly end, it was apparent that the public interest was best conserved by maintaining this relative position between the companies as to territory and preventing either company from encroaching upon the portions now served by the other.

Recent Court Decisions

Owner of Building Has No Duty to Warn Employee of Independent Contractor Concerning Electric Wires.—Forance vs. Bigelow-Hartford Carpet Company was a suit for damages because a workman sent by an outside contractor to paint a ceiling was injured when he seized an electric wire to keep from falling off a stepladder. The Supreme Judicial Court of Massachusetts found that no charge of negligence lay against the owner of the building, who was under no obligation to warn the workman against taking hold of the wire. (154 N. E. 174.)*

Retained Jurisdiction by State Commission a Safeguard Against Confiscation.—Sustaining a rate order of the Corporation Commission against the protest of the Mullendore Gas Company as opposed to the city of Stillwater, the Supreme Court of Oklahoma, holding that the rates had been fixed on proper principles of valuation, observed: "Ordinarily, time alone can satisfactorily demonstrate in a case like this whether a rate fixed by order of the Corporation Commission will prove so unremunerative as to be confiscatory in the sense in which that term is used in rate-making cases. And where the commission expressly retains jurisdiction of the cause and reserves the right, upon subsequent application or upon its own motion, to further investigate the rates authorized in the order, this sufficiently protects the companies as against their claim that the new rates will prove confiscatory." (250 Pac. 895.)

Users of Electricity Cannot Force Continuation of Contract for Its Sale by One Corporation to Another.—In Witbeck vs. Niagara, Lockport & Ontario Power Company, the Appellate Division of the Supreme Court of New York held (as noted on Nov. 20, page 1088) that local manufacturers could not force the continuance of a contract for the sale of energy by one power company to another at a rate that had proved beneficial to consumers. The gravamen of this decision as embodied in the printed report is as follows: "Where an electric power corporation which was incorporated and acquired property with the aid of a business men's association contracted to sell to another power corporation a specified quantity of power at a specified price under contract terminable by mutual consent, even if the original incorporators and their successors were 'fiduciaries' for users or potential users of power in the town, they had discretion to modify the contract, unlimited except by the requirement of good faith, and users or potential users had no legal right to the continued and unchanged existence of contract," and could not "restrain modification thereof on the ground that the first corporation was estopped from consenting to modification." (218 N. Y. S. 339.)

Summary of Supreme Court Findings in Indianapolis Water Company Case.—In view of the large amount of attention attracted by the United States Supreme Court decision in the case of McCardle (Public Service Commission) vs. Indianapolis Water Company, already noted in the ELECTRICAL WORLD for Nov. 27 (page 1140), the following summary of the different points in the decision is printed: (1) In public utility rate cases consideration must be given to prevailing wages and prices and a forecast made of wages and prices for a reasonable period ahead. (2) The court must determine whether rates complained of will yield a reasonable return on the value of property at time of investigation and for a reasonable period ahead. (3) Owners must bear decline or increase in fluctuating values of utility properties. (4) Amount paid for land in early years of old enterprise and cost of plant elements constructed prior to war prices are no indication of present value. (5) If there is no tendency of prices upward or downward, nor probability of substantial change, then present value of land plus cost of constructing plant, less depreciation, is a fair measure of value. (6) The high level of prices and wages in 1922 and 1923 should be taken into account. (7) Supreme Court may take judicial notice that there has been no substantial general decline in prices of labor or materials since time as of which values were found. (8) Average prices for ten-year period ended in 1921, adopted as price level in determining value as of Jan. 1, 1924, were too low. (9) Allowance for materials, working capital, etc., not excessive. (10) Company entitled to have value of water rights in river included. (11 and 12) Going-concern value must be considered, and allowance equivalent to 9½ per cent of value of physical property was sustained. (13) A straight deduction of about 25 per cent of estimated cost new to cover accrued depreciation was improper. (14) Testimony of valuation experts preferable to calculations based on averages and assumed probabilities. (15) Company entitled to have cost of canal included rather than cost of steam plant. (16) Value of plant actually used, and not estimated cost of a different plant, is to be ascertained. (17) Seven per cent is a reasonable rate of return for a water company. (18) Rate yielded on public utility bond investments, plus brokerage, is not a controlling consideration on compensation. (19) Supreme Court may examine record to determine whether facts justified lower court's conclusion. (47 S.C.R. 144.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Financial and Corporate

Utility Stocks Irregular

But Bond Market Is Enjoying a Period of Unusual Firmness—Offerings Short of Demand

BONDS occupy the center of interest among public utility securities. During the past two weeks demand for high-grade power and light bonds has been greater than the supply. New issues are sold without difficulty in record time, and many of the old issues, some of which have been dormant for months, are moving. Negotiations between banking firms and borrowing companies are said to be going through with greater dispatch than is usual, to take advantage of the present favorable market. There is no indication of any immediate change in the easy-money situation, which, incidentally, is easier than at this time for some years, and there appears to be a larger amount of funds available for investment than there has been for some time.

Preferred stocks also are in active demand. There have been a number of price gains among existing issues, and the new issues are being well received. Standard Gas & Electric prior preferred and Arkansas Light & Power preferred were among the leaders. Other less notable gains were made in a number of issues.

Common stocks have been much more irregular. The market uncertainty seems to have affected a number of these stocks, but there were more gains than losses, although the gains were smaller in most cases. The average of a representative group of stocks compiled by the ELECTRICAL WORLD gained one point to 96, there being eight gains, three losses and four unchanged out of a group of fifteen issues.

New Italian Loan Floated

A new foreign offering was made during the past week, a six-million-dollar issue of external first mortgage sinking-fund gold bonds, series A, of the United Electric Service Company (the Unione Esercizi Elettrici). The United Electric Service Company, a hydro-electric operating company, directly or through subsidiaries, generates, transmits and distributes electricity, serving over 1,000 communities in Italy with an aggregate population estimated at over 4,500,000, of which over 358,000 are customers of the company.

These 7 per cent gold bonds, dated Dec. 1, 1926, and maturing Dec. 1, 1956, were priced at 92½ and accrued interest to yield 7⅝ per cent. They will be secured, in the opinion of counsel, by a direct first mortgage on the physical properties of the company and its subsidiaries subject only to prior mortgages on certain parcels. Attached to each definitive bond will be a detachable warrant entitling the holder to purchase on or before Dec. 31, 1931, 100 shares of the fully paid capital stock of the company (par value 50 lire) at the equivalent of 50 lire a share, at the rate of exchange current at the time of purchase of the shares.

American Water Works & Electric Pays Extra Dividends.—Directors of the American Water Works & Electric Company, Inc., in addition to declaring the usual quarterly dividend of 1¾ per cent on the 7 per cent cumulative first preferred stock at their meeting Jan. 5, increased the regular quarterly cash dividend on the $20 par value common stock from 1½ per cent to a regular 2 per cent. or at the rate of 8 per cent per annum, against a previous rate of 6 per cent, and declared an additional dividend of 2½ per cent on the common stock, payable in common stock at par, all dividends payable Feb. 15 to holders of record Feb. 1, 1927.

Company Reports

The following statements of earnings have been issued by electric light and power companies:

Name of Company	Gross Earnings Twelve Months Ended Nov. 30 1926	1925
American Wtr. Wks. & Elec.	$45,013,322	$40,766,538
Assoc. Gas & Elec. System.	*28,325,873	*15,900,413
Engineers Public Service...	26,345,520	.....
Federal Light & Traction.	†5,977,103	†5,318,315
Idaho Power.....	2,872,883	2,814,629
Nevada-California Electric	5,016,212	4,851,659
Northern States Power....	27,647,374	21,684,804
Utah Power & Light.....	10,437,622	9,807,969
Western United Gas & Elec.	6,701,016	5,997,259

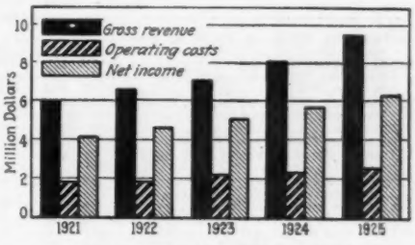
* Twelve months ended Oct. 31.
† Eleven months ended Nov. 30.

Niagara Falls Power's Low Operating Ratio

Most Recent Statement Shows Net Earnings of $2.22 a Share on Common as Against $1.89 a Share a Year Previously

THE most recent statement of the Niagara Falls Power Company shows an increased volume of business and an unusually low operating ratio. These factors were responsible for an increase of 21 per cent in gross revenue and of 12 per cent in net. The report made available as of last September shows net income at the rate of $2.22 a share on common. Unfortunately operating costs increased more rapidly than gross revenue, hence the smaller rise in net income.

The financial set-up of Niagara Falls Power as of December, 1925, shows obligations amounting to 51 per cent of total capitalization. Gross revenue was one-eighth of total capital outstanding, which corresponded almost exactly with the stated value of fixed capital. In-



NIAGARA FALLS POWER SHOWS STEADY GROWTH

SET-UP, EARNINGS AND FINANCIAL POSITION OF NIAGARA FALLS POWER COMPANY

1. **Financial Set-Up** (December, 1925):
   Ratio debt to capitalization, 51 per cent.
   Ratio gross revenue to capitalization, 1 to 8.
   Ratio funded debt to gross, 4 to 1.
   Ratio investment to capitalization, 100 per cent.
   Ratio investment to gross, 8 to 1.
2. **Revenue Record:**
   Operating ratio, 33 per cent.
   Ratio revenue to total assets, 1 to 9.
   Ratio net earnings to revenue, 67 per cent.
   Times bond interest earned—More than three times.
   Preferred dividend earned, $4.40.
   Common dividend earned, $2.51.
   Debt per dollar of net, $5.90.
3. **Business Progress:**
   Kilowatt-hours sold in 1925, 2,488,240,158.
   Revenue increase over 1924: Gross, 11 per cent; net, 7 per cent.

debtedness per dollar of net earnings, a fairly well recognized yardstick, was $5.90, which is well within the range considered as satisfactory.

The earning ratio of the company, or the ratio between net earnings and capitalization, was 8.6 per cent and showed a satisfactory improvement over a period. Net earnings amounted to 67 per cent of revenue, and bond interest was earned more than three times. A surplus of $3,971,033, after charges allowed for earnings of $4.40 a share on preferred and $2.51 a share on common, was shown for the year 1925.

Changes in National Electric Power Company

As a result of the acquisition of control in the National Electric Power Company by Samuel Insull, the following changes in the directorate of the company have been announced:

Albert Emanuel, founder of National Electric, has resigned as president and will be succeeded by Harry Reid of Indianapolis, formerly president of the Interstate Public Service Company and

the Kentucky Utilities Company. Victor Emanuel, son of Albert Emanuel, resigns as chairman and will be succeeded by Mr. Insull. C. B. Ziegler, former secretary of National Electric, becomes a director, and with him on the board will be Samuel Insull, Martin J. Insull and Mr. Reid. Victor Emanuel, A. C. Allyn, Charles D. Makepeace, W. H. Siebert and R. E. Riggs will remain as directors of National Electric. The change in directorship marks the termination of the Emanuel "family" control of the company and the formal recognition of domination by the Middle West interests.

Six Assistant Vice-Presidents for Stone & Webster and Blodget.—The following assistant vice-presidents have been elected by the board of directors of Stone & Webster and Blodget Incorporated, with headquarters at Boston: J. P. Lane, Charles Sprague and John H. Davison, formerly with Stone & Webster, Inc., and Augustus W. Soule, John M. Gilbert and Rufus C. Cashman, Jr., formerly with Blodget & Company.

New Capital Issues

During the week ended Jan. 13 several sizable loans were floated by electric light and power companies. The Electric Bond & Share Company, which, as announced in last week's issue of the ELECTRICAL WORLD, is planning to double its capital stock, issued 6 per cent cumulative preferred stock to the amount of $15,000,000, the price being $107.50 per share and accrued dividends from Feb. 1, 1927, to yield 5.58 per cent. Proceeds from the sale of this preferred stock will be used for general corporate purposes of the company in expanding its business.

Another fifteen-million-dollar offering was made by the Southern California Edison Company in the form of refunding mortgage gold bonds, series of 5's, dated July 1, 1926, and due July 1, 1951. These bonds were priced at 98½ and interest, yielding over 5.10 per cent.

The largest individual offering of the week was made by the San Joaquin Light & Power Corporation in the form of unifying and refunding mortgage 30-year 5 per cent gold bonds, series D, at 98½ and accrued interest to yield about 5.10 per cent. This piece of financing involved a total of $25,000,000. Proceeds of this issue will be used to retire all outstanding first and refunding mortgage bonds and all outstanding series A 7 per cent and series C 6 per cent unifying and refunding mortgage bonds (aggregating $22,725,000 principal amount), and to reimburse the treasury for expenditures for additions, extensions or improvements to its plants and system.

The Florida Power & Light Company participated in the week's activities to the extent of 70,000 shares of cumulative preferred stock offered at $100 per share and accrued dividends, to yield 7 per cent. The company, which supplies electric power and light service in 90 communities in Florida, is controlled through ownership of all its second preferred and common stocks by the American Power & Light Company. The Electric Bond & Share Company supervises (under the direction and control of the boards of directors of the respective companies) the operations of the American Power & Light Company and the Florida Power & Light Company and of the subsidiaries of these companies.

Stock Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless o therwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday Jan. 11	Low 1926	High 1926
ABITIBI PWR. & PAPER, 4% com.—no par	*k* 85	70⅛	98
Adirondack Pwr. & Lt.—7% pf.	104	101	108½
Adirondack Pwr. & Lt.—8% pf.	110	101	115
Ala. Pwr., 7% pf.	108½	103	109½
Allis-Chalmers Mfg., 7% pf.	*k*110½	105	111
Allis-Chalmers Mfg., 6% com.	*k* 89	78½	94
Aluminum Co. of Amer., com.	69	54½	76
Aluminum Co. of Amer., 6% of	101	98½	103½
Amer. & Foreign Pwr., pf. 25% pd.	*m*110	...	...
Amer. & Foreign Pwr., 7% pf.—no par	89½	79	98
Amer. & Foreign Pwr., com.—no par.	*k* 22½	14½	42⅛
Amer. Bosch Magneto, com.—no par	16⅛	16	34½
Amer. Brown Boveri Elec†	38⅛	30½	50
Amer. Brown Boveri Elec., pf. $7	*k* 97⅛	86½	97½
Amer. Gas & Elec., 6% pf.—no par.	96½	91	98½
Amer. Gas & Elec., com.†—no par.	73⅛	64	111½
Amer. Lt. & Trac., 6% pf.	*k*114	105	132
Amer. Lt. & Trac., com.†	230	195	264
Amer. Pwr. & Lt., 6% pf.	97½	92	98½
Amer. Pub. Serv., 7% pf.	*k* 96	92	97½
Amer. Pub. Serv., com.†	*k* 50	45	80
Amer. Pub. Utilities, 7% pr. pf.	86	86	95
Amer. Pub. Utilities, 7% ptc. pf.	75	73	89
Amer. Pub. Utilities,com	*m* 66	68	82
Amer. States Sec., A	4	2	9½
Amer. States Sec., B	4	1½	5
Amer.Superpwr.,$6p f.—25	26½	23	27⅛
Amer. Superpwr., 7% pf.	*l*94	93	95½
Amer.Superpwr., Class A†—no par.	*k* 27⅛	19½	37⅛
Amer.Superpwr., Class B†—no par.	28⅛	21⅛	39
Amer. Wtr. Wks. & Elec., 7% pf.	107	101⅛	108½
Amer. W. W. & E., com. $1.20—20.	66⅛	43⅝	74
Anaconda Copper Cap. $3	48⅛	41⅛	51½
AppalachianElectric Pwr., 7% pf.	*k* 99	90	101
AppalachianElec. Pwr., 2d pf., 7%	*k* 98	99	102
Appalachian Elec. Pwr.,com.	*m* 78	...	...
Arizona Pwr., 7% pf.	70	60	82
Arizona Pwr., com.	21	19	39½
Arkansas Cent. Pwr., pf.—$7 no par.	*k*101	99	107
Arkansas Lt. & Pwr., 7% pf.	103	96	104
Arkansas Lt. & Pwr., com.	*k*100	110	115
Asheville Pwr. & Lt., 7% pf.	*l*107½	107*	107*
Assoc. Gas &Elec., $3. 50—50	50⅛	...	...
Assoc. Gas & Elec., pf.—$6—no par.	*k*85⅛	79½	86½
Assoc. G.&E., Class A, $2.50—no par	*k* 35⅛	25⅛	38⅛
BABCOCK & WILCOX, 7% com.	115	117	151
Binghamton L., H. & P., $6 pf.	*k* 91	90	95
Birmingham Elec., pf.—$7—no par.	106	101	108
Blackstone Valley G. & E., $6 pf.	*k*102	103	106
Blackstone Valley Gas & Elec., 10% com.—50	*k*104	100½	106
Blaw-Knox, com.†	*t* 70	45	80
Brazilian Trac., Lt. & Pwr., com.†	108⅛	...	...
Broad River Pwr., 7% pf.	96	93	98
Brooklyn Edison, 8% com.	153	133	163
Buffalo, Niagara & East. Pwr., pf.—25	25½	22⅛	26
Buffalo, Niagara & East. Pwr., com.† —no par	*l* 27⅛	....	....
CALIFORNIA ELEC. GENERATING, 6% pf.	*k* 93	89	95
California Ry. & Pwr., 7% pf.	*k*125	88	130
Carolina Pwr. & Lt., pf.—$7—no par	107½	102	108½
Central & S.W. Util., 7% pf.—no par	*a* 99½	89½	96⅛
Central & S.W. Util., pr. ln. $7 pf.—no par	*a* 99	93	100
Central Ariz. Lt. & Pwr., 8% pf.	102	103	108
Central Ark. Ry. & Lt., 7% pf.	101	99	101
Central Ill. Pub. Serv., 6% pf.	*k* 88	89	91
Central Ind. Pwr., 7% pf.	85⅛	84½	93½
Central Pwr. Lt., 7% pf.	108	94	103½
Central States Elec., 7% pf.	90	91	97
Central States Elec., com.†	*m*200	200	230
Century Elec., 6% com.	*m*117	110	117
Chicago Fuse Mfg., com.—$2.50 no par	*m* 30⅛	30	35
Cincinnati Gas & Elec., 5% com.	*g* 94⅛	93½	94½
Cities Service, 6% pf.	*k*91⅛	82½	92½
Cities Service, pf. B—10	*k* 8	7	8⅛
Cities Service, pf. BB—100	*k*82⅛	74	83
Cities Service, com.—20	*k*50⅛	37⅛	51
Cities Service, Bks. Shrs.—10	*m*25	...	...
Clarion River Pwr., 8% pf.	*k* 98	93	95
Cleveland Elec. Illg., 6% pf.	108	103	109
Cleveland Elec. Illg., 10% com.	300	240	310
Colorado Pwr., 7% pf.	*k* 95	96	97
Columbia Gas & Elec., 7% pf.	*k*116½	111½	117⅛
Columbia G. & E. com. $2.60—no par	88	63½	90⅛
Columbia Ry., Gas & Elec., 6% pf.	*k* 94	65	96
Columbus Elec. & Pwr., 2d. pf.	103	...	...
Columbus Elec. & Pwr., 9% com.	55	...	...
Columbus Ry., Pwr. & Lt., 6% 1st pf.	98	98	99½
Columbus Ry., Pwr. & Lt., 6½% pf. B	95	92	97
Columbus Ry., P. & L., com.—no par	75	70	85
Commonwealth Edison, 8% com.	*a*140⅛	135½	145
Commonwealth Pwr., 6% pf.	92½	82	93½
Commonw'th Pwr., $2, com.—no par	44⅛	29	43⅛
Conn. Lt. & Pwr., 8% pf.	118	117	121
Conn. Lt. & Pwr., 7% pf.	112	108	113
Cons. Gas of N. Y., pf.†—50	60⅛	57	62½
Cons. Gas of N. Y., com $5—no par.	109	87	115⅛
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6% pf.	*k*105	102	107⅛
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6½% pf.	*e*111	108½	112⅛
Cons. Gas, Elec. Lt. & Pwr. of Balti., 7% pf.	*e*114	109	115
Cons. Gas, Elec. Lt. & Pwr. of Balti., 8% pf.	*e*127	124	128⅛
Cons. Gas, Elec. Lt. & Pwr. of Balti., com. $2.50—no par.	52	45	57⅛
Consolidated Pwr.&Lt., 7% pf.	106	100	107
Consumers Pwr., 6% pf.	99½	95	101⅛
Consumers Pwr., 6.6% pf.	104	101½	106
Continental Gas & Elec., 7% ptc. pf.	103⅛	96	109½
Continental Gas & Elec., 7% pr. pf.	100	95½	101⅛
Conti. G. & E. com. $4.40—no par.	200	85	210
Crocker Wheeler, com.†	27	14	26
Crocker Wheeler, 7% pf.	68	50	65
DALLAS PWR. & LT., 7% pf.	107	102	110
Dayton Pwr. & Lt., 6% pf.	100½	95	100
Detroit Edison, 8% com.	136	123⅛	141⅛
Dubilier Condenser, com.—no par.	3⅛	3⅛	11
Dubuque Elec., 6% pf.	*k* 93	93	98⅛
Duquesne Lt., 7% pf.	116	111	116⅛
EASTERN NEW YORK UTIL., $7 pf.	*k*101	80	104
Eastern New York Util. com.	*k* 65	70	75
Eastern States Pwr., $7, com.	10	12	32⅛
Eastern States Pwr., pf.	93⅛	89	95
East. Tex. Elec., 7% pf.	105	100	107
East. Tex. Elec., com. $5—no par.	*k* 75	70	80
Edison Elec. of Boston, 12% com.	*d*230	207	250
El Paso Elec., com. $5—no par.	*k* 70	70	94
El Paso Elec., 7% pf.	102	102	106½
Elec. Bond & Share, 6% pf.	*i* 108	108⅛	*108⅛*
Elec. Bd. & Sh. Sec. com. $1—no par	*l* 71	70⅛	* 72⅛*
Electric Household Util.†	*a* 13	11⅛	25
Elec. Investors, 6% pf.—no par.	93	87	95
Elec. Investors, com.†—no par.	35⅛	30⅛	74⅛
Elec. Investors, 10% pd. receipts.	*k* 20	12	56
Elec. Pwr. & Lt., ctfs. pf.	96⅛	89⅛	98⅛
Elec. Pwr. & Lt., ctfs., 40% pd.	104⅛	99	115
Elec. Pwr. & Lt., ctfs, full pd.	*k*104⅛	102⅛	110⅛
Elec. Pwr. & Lt., ctfs., com.—no par.	18⅛	15⅛	34⅛
Elec. Refrig. cap †	37⅛	33⅛	78⅛
Elec. Ry. Securities, com.—no par.	*m* 5⅛	4⅛	7
Elec. St. Battery com. $5. 25—no par	78⅛	71⅛	94⅛
Elmira Wtr., Lt. &R.R., 7% pf.	99⅛	97⅛	101⅛
Emerson Elec., pf.	*m*105	101	105
Empire Pwr., A $6	27	21	32
Engr. Pub. Serv., pf.—no par.	94	92⅛	96⅛
Engr. Pub. Serv., com. $7—no par.	22⅛	19⅛	24⅛
Eureka Vacuum Cleaner, com. $4—no par	66⅛	43	68⅛
FAIRBANKS MORSE, 7% pf.	108⅛	106⅛	115
F.-M., com.—$2. 60—no par.	40⅛	37⅛	59⅛
Federal Lt. & Trac., com.†	42	28	47⅛
Federal Lt. & Trac., pf. $6.	*k* 91	86	94
Ft. Worth Pwr. & Lt., 7% pf.	*l* 110	109*	112*
GALVESTON-HOUSTON ELEC., 6% pf.	67	65	70
Galveston-Houston Elec., com.	25	21	30
Gen. Elec., 8% com.	84⅛	79	95½
Gen. Elec., special—10	11⅛	11	11⅛
Gen. Gas & Elec. (Del.) com. A, $1.50—no par	*k* 41	34	59
Gen. G.&E. (Del.) com. B—no par.	*m* 42	36	48⅛
Gen. G.&E. (Del.) pf. A. $8—no par.	*k*113	105⅛	113
Gen. G.&E. (Del.) pf. A $7—no par.	*k*100	95	100
Gen G.& E. (Del.) pf.B$7	*k* 94⅛	92⅛	96
Gen. Pub. Serv., $7 pf.	*k*103	102	106
Gen. Pub. Serv., com.	12	11	16⅛
Ga. Lt., Pwr. & Rys., 6% pf.	*m* 88	82	98
Ga. Lt., Pwr., & Rys., com.	*m* 60	65	80
Ga. Ry. & Pwr., 8% pf.	*k*118	112	122
Ga. Ry. & Pwr., 7% pf.	105⅛	100⅛	108⅛
Ga. Ry. & Pwr., 4% pf.	*m*119	...	...
Ga. Ry. & P wr.,4% com.	120	...	...
Gt. Western Pwr.,7% pf.	*k*102⅛	103⅛	103⅛
IDAHO PWR., 7% pf.	104⅛	103	106
Ill. No. Utilities, 6% pf.	*k* 88	88	92
Ill. Pwr. & Lt., 7% pf.	98⅛	96⅛	100⅛
Ingersoll Rand com. $8	*k* 92	80⅛	104
Int. Combus. Engr., com. $2—no par	48⅛	33⅛	64⅛
Int. Util., Class A—$3. 50—nopar	28⅛	24	39
Int. Utilities, Class B—no par.	3⅛	3⅛	9⅛
Interstate Pwr., pf.—$7—no par.	92⅛	90	98
Interstate Pub. Serv., 7% pf.	*k* 96	96⅛	99⅛
Iowa Ry. & Lt., 7% pf.	*k* 96	98	100
JERSEY CENTRAL PWR. & LT., 7% pf.	97	94	98⅛
Jersey Cent. Pwr. & Lt., 7% ptc. pf.	*k*107	95⅛	112
Jersey Cen. Pwr. & Lt., com.—no par	*k* 25	25	50
Johns-Manville, com.†—no par.	60	50⅛	62⅛

Stock Exchange: *a*Chicago; *b*St. Louis; *c*Philadelphia; *d*Boston; *e*Baltimore; *f*Montreal; *g*Cincinnati; *h*San Franisco; *i*Pittsburgh; *j*Washington. *k*Bid price Saturday, Jan. 8. *l*Bid price Wednesday, Jan. 12. *m*Latest quotations available. *1927. †Dividend rate variable.

Stock Quotations of Electric Light and Power and Manufacturing Companies (Continued)

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday Jan. 11	Low 1926	High 1926
KANSAS CITY PWR. & LT. pf.$7	k113¼	107¼	115
Kansas Gas & Elec., 7% pf.	102½	101	105
Kentucky Hydro-Elec., 7% pf.	a 95	91½	96
Kentucky Sec., 6% pf.	82	75	85
Kentucky Sec. 5% com.	107	90	108
Kentucky Utilities, 6% pf.	k 95	90	96½
Keystone Pwr. & Lt., 7% pf.	k 97	95	98½
LACLEDE GAS LT., 8% com.	k175	146	196½
Lehigh Pwr. Sec., com.—no par.	18	16	22
Long Island Ltg., 7% pf.	108½	105	112
Long Island Ltg., com. $2—no par.	k140	120	150
Los Angeles Gas & Elec., 6% pf.	98½	95½	100
Louisville Gas & Elec., cl. A. $1.75	24½	22½	26½
MAN. ELEC. SUPPLY, cap. $4.25 —no par	k 55½	44	87½
Manila Elec., com.†—no par.	k 38½	27½	45½
Maytag Mfg., com. .50—no par.	k 24	19	24½
Memphis P. & L., pf.—$7—no par	k108	103	110
Metropolitan Ed., pf.—$6—no par.	95	91½	98
Metropolitan Ed., pf.—$7—no par.	104	102	108
Metropolitan Ed., com. $5—no par.	k 60	45	60
Middle West Utilities, 7% pf.	a107½	97	111½
Middle West Util., 7% pr. lien pf.	a118½	106½	123
Middle West Util., com. $6—no par	a112	108	135
Midland Utilities, pr. ln. 7% pf.	a 98½	97	103
Midland Utilities, 7% pf. A.	a 97	96	99½
Milwaukee Elec. Ry. & Lt., 7% pf.	k101	100	103
Milwaukee Elec. Ry. & Lt., 6% pf.	k 98	87	100
Minn. Pwr. & Lt., 7% pf.	l104	104*	106*
Miss. Pwr. & Lt., $8 pf.	k106	102	107½
Miss. River Pwr., 6% pf.	94	93	96
Miss. River Pwr., com.	62	....	....
Mohawk Hudson Pwr., 1st pf.—$7 —no par	104½	100	106½
Mohawk Hudson Pwr., 2d pf.—$7 —no par	98	90	102
Mohawk Hudson Pwr., com.—no par	21½	20½	23½
Montana Pwr., 7% pf.	m117	112½	119½
Montana Pwr., 4% com.	82½	69½	86½
Montreal Pwr., 7½% com.	f 69½	....	....
Mountain States Pwr., 7% pf.	96	97	102
Mountain States pwr., com.†	18	....	....
NASSAU & SUFFOLK LTG., 7% pf.	98½	93	101
National Carbon, 8% pf.	m130	124	130
National Elec. Pwr., A†	24½	15½	26½
National Elec. Pwr., 7% pf.	a 94	93	95
National Lt., Ht. & Pwr., com.	k 24	22	25
National, Light, Ht. & Pwr., 5% pf.	k 70	71	73
National Pwr. & Lt., pf.—$7—no par	101	98½	104½
National Pwr. & Lt., com.†—no par.	21½	16½	38½
National Pub. Serv., 7% pf.	90	87½	95
National Pub. Serv., 7% ptc., pf.	107	96	112
National Pub. Serv., A com. $1.60— no par	21½	15½	24
National Pub. Serv., B com.—no par	15	10	17½
Nebraska Pwr., 7% pf.	l107½	107½*	108½*
Nevada-Calif. Elec., com.	26½	18½	44½
New Brunswick Pwr., 7% pf.	k 58	30	60
New Eng. Pub. Serv., pr. ln. pf. $7.	k 99½	98	101
New Eng. Pub. Serv., pf. $7.	k 93	95½	97
New Orleans Pub. Serv.—7% pf.	102½	100	105
N. Y. & Queens Elec. Lt. & Pwr., 5% pf.	90	89	95
N. Y. Central Elec., 7% pf.	k 99½	98	100
Newport News & Hampton Ry., Gas & Elec., 5% com.	k109	98	112
Newport News & Hampton Ry., Gas & Elec., 7% pf.	k109	98	114
Niagara Falls Pwr., 7% pf.—25.	29	27½	29½
Niagara, Lock. & Ont. Pwr., 7% pf.	k111	110	111½
No. Amer., 6% pf.—50.	k 51½	49	52½
No. Amer., com.—10.	46½	42	67
No. Amer. Edison, $6 pf.—no par.	97½	93	95
No. Amer. Lt. & Pwr., 7% pf.	k101	88	104
No. Caro. Pub. Serv., pf.—$7—no par	94	89	96
Northeastern Pwr., com.	18½	15½	36½
No. Indiana Gas & Elec., 7% pf. A.	k102½	98	103½
No. N. Y. Utilities, 7% pf.	104	103	105½
No. Ohio Pwr., com.—no par.	10½	9½	26½
No. Ohio Trac. & Lt., 6% pf.	k 76	78	81
No. Ohio Trac. & Lt., 7% pf.	k 90	88	96
No. Ont. Lt. & Pwr., 6% pf.	83	75	88½
No. Ont. Lt. & Pwr., 4% com.	k 74	73	78
No. States Pwr., 7% pf.	k100½	99½	103½
No. States Pwr., 8% com.	k110½	98½	136½
No. Texas Elec., 6% pf.	58	48	65
No. Texas Elec., 4% com.	23	15	45
OHIO BRASS, com. B $4—no par.	k 77½	74	80
Ohio Brass, 6% pf.	k100	98	101
Ohio Gas & Elec., 7% pf.	k 94	90	95
Ohio Pwr., 6% pf.	98	90	97
Ohio Pub. Serv., 6% pf.	k92	93	94
Ohio Pub. Serv., 7% pf.	k103½	101	105
Ohio River Edison, 7% pf.	102½	98½	105
Oklahoma Gas & Elec., pf.	96	....	....
PACIFIC GAS & ELEC., 6% pf.	101½	99	102½
Pacific Gas & Elec., 8% com.	128½	118	133½
Pacific Pwr. & Lt., 7% pf.	l102½	102½*	102½*
Parr Shoals Pwr., 6% pf.	k 92	90	97½
Penn Cent. Lt. & Pwr., $5 pf.—no par	c 72	70½	91
Penn-Ohio Edison, 7% pf.	97½	94	97½
Penn-Ohio Elec., 7% pf.	k 95	93	96
Penn-Ohio Pwr. & Lt., 7% pf.	98	94	100
Penn-Ohio Pwr. & Lt., 8% pf.	106	100	111
Penn Pwr. & Lt.—$7—no par.	l106½	105½*	106½*
Penn Pub. Serv., 7% pf	k103	96	103
Penn Pub. Serv., 6% pf.	k 87	85	90
Penn Wtr. & Pwr., 8% com.	c178	140	180
Phila. Co., 6% pf.—50.	k 50½	45	51½
Phila. Co., com.—50.	87	59½	91
Phila. Elec., 8% com.—25.	c 53½	41½	67½
Pittsburgh Utilities, 7% pf.—10.	m 19½	14½	20½
Portland Elec. Pwr., 7% pf.	97½	97	101
Portland Elec. Pwr., 6% pf.	81	71	87
Portland Elec. Pwr., 6% 2d pf.	70	71	75
Portland Elec. Pwr., com.	30	26	48
Potomac Elec. Pwr., pf.	j107½	....	....
Pwr. Corp. of N. Y., com. $1—no par	m 79	77½	90½
Pwr. Sec., pf.—no par.	k 37	10	39
Pwr. Sec., com.—no par.	k 6	4	13
Public Serv. of Colorado, 7% pf.	l 99	....	....
Pub. Serv. of N. J., 7% pf.	109	103½	110
Pub. Serv. of N. J., 8% pf.	125	115	124½
P. S. of N. J., $5 com.—no par.	32½	31½	33½
Pub. Serv. of No. Ill., 6% pf.	a104	101	103
Public Serv. of No. Ill., 7% pf.	a114	112	116½
P. S. of No. Ill., com. $8—no par.	a133	121	140
Pub. Serv. of No. Ill., 8% com.	a132½	128	143
Pub. Serv. of Okla., 7% pf.	k 99	92	100
Pub. Serv. Elec. & Gas, 6% pf.	102½	97	104½
Pub. Serv. Elec. Pwr., 7% pf.	k114	106	114
Puget Sound Pwr. & Lt., 7% pf.	103	103	108
Puget Sound Pwr. & Lt., 6% pf.	84	82	84½
Puget Sound Pwr. & Lt., com.	31	22	66
RADIO CORP. OF AMER., 7% pf.—50	52	44½	53½
Radio Corp. of Amer., com.—no par.	53½	32	61½
Republic Ry. & Lt., pf.	115	95	120
Republic Ry. & Lt., com.	125	75	116
Rochester Gas & Elec., 5% pf.	m 95	....	....
Rochester Gas & Elec. Ser. D, 6% pf.	102	98	102
Rochester Gas & Elec., 7% pf.	102½	105	107
SAFETY CABLE, com.†	55	42½	55½
San Joaquin Lt. & Pwr., 7% pf.	k106	97½	108
St. Joseph Ry., L., H. & P., 5% pf.	k 67	60	70
Servel Corp.	9½	5½	22½
Sierra Pacific Elec., com.	24	23	28½
Sioux City Gas & Elec., 7% pf.	100½	96	101½
Southeastern Pwr. & Lt., pf.—$7 no par	l101	97	103
Southeastern Pwr. & Lt., $6 ptc. pf.	l 67½	60	68½
Southeastern Pwr. & Lt., com.—no par	32½	20	46½
So. Calif. Edison, 8% pf.	k 34	32½	36
So. Calif. Edison, 7% pf.	27½	27½	28
So. Calif. Edison, 6% pf.	24½	24½	25
So. Calif. Edison, 8% com.	32½	30	33
Southern Cities Utilities, 7% pf.	85	85	90
Southern Cities Utilities, com. $4.	30	....	....
Southwestern Lt. & Pwr., A $3.	63	52	60
Southwestern Lt. & Pwr., B.	63	38	58
Southwestern Lt. & Pwr., $6 pf.	82	78	82
Southwestern Pwr. & Lt., 7% pf.	k104	100	105
Springfield (Mo.) Ry. & Lt., 7% pf.	k 97	95	100
Standard Gas & Elec., 8% pf.	58	53½	57½
Standard Gas & Elec., 7% pf.	104½	97½	105½
Standard G. & E., com. $3—no par.	55½	51	69
Standard Pwr. & Lt., 7% pf.	98	90	98½
Staten Island Edison, pf.—$6—no par	96	93	97½
Superheater, $6 com.—no par.	162	138	173
Syracuse Lighting, 7% pf.	k102	105	107
Syracuse Lighting, 8% pf.	k115	....	....
Syracuse Lighting, 8% com.	k300	200	355
TAMPA ELEC., com. $2	47	45½	67
Tenn. Elec. Pwr., 6% pf.	91	87	90
Tenn. Elec. Pwr., 7% pf.	102	98	105
Terre Haute, Ind. & East. Trac., 5% pf.	k 20	20	37
Terre Haute, Ind. & East. Trac., com.	k 1	1	7
Tex. Pwr. & Lt., 7% pf.	l107½	107*	109*
Tide Water Pwr., 8% pf.	105	101	106
Timken Roller Bear., com.—$4 no par	81½	44½	85½
Toledo Edison, 8% pf.	k114½	112	115½
Toledo Edison, 7% pf.	k104½	101	104½
Toledo Edison, 6% pf.	k 92	89	94
Toledo Edison, 6% com.	k100	....	....
Tri-City Ry. & Lt., 6% pf.	k 90	87½	90
UNITED GAS & ELEC., 6% pf.	99	94	97
United Gas & Elec., com.—no par.	m 57	56	66
United Gas & Elec. (N. J.) 5% pf.	68	70	75
United Gas Impr., 8% com.—50.	c 93½	84½	144½
United Lt. & Pwr., pf.—$4—no par.	k 50	44	53
United Lt. & Pwr., pf.—$6.50—no par	k 86½	81	91
United L. & P., com. A .48—no par.	15½	10½	28
United L. & P., com. B .48—no par.	k 16	13	29
Utah Pwr. & Lt., 7% pf.	l104½	103½*	104½*
Utica Gas & Elec., 7% pf.	104½	103	106
Utica Gas & Elec., 8% com.	k200	....	....
Utilities Pwr. & Lt., 7% pf.	94	92	98
Utilities Pwr. & Lt., com. A $2.	27	27½	37
Utilities Pwr. & Lt., com. B $1—no par	k 13½	13½	18
VERMONT HYDRO-ELEC., 7% pf.	94½	94	96
Virginia Elec. & Pwr., 7% pf.	k105	101	105
Virginian Pwr., 7% pf.	k108	102	104
Virginian Pwr., com.	k 70	65	75
WAGNER ELEC., 7% pf.	b 69	69	69
Wagner Elec., com.†—no par.	b 20	18½	20
Washington Ry. & Elec., 5% com.	j178	....	....
Washington Ry. & Elec., 5% pf.	j 90½	....	....
Washington Wtr. Pwr., 8% com.	k136	130	138
West Mo. Pwr., 7% pf.	m 92	....	....
West Penn Elec., 7% pf.	102½	95½	102½
West Penn Elec., Cl. A $7.	k 99½	88½	98½
West Penn Pwr., 7% pf.	k113	108	115
West Penn Pwr., 6% pf.	102	95	103
West Virginia Lt., Ht. & Pwr., 7% pf.	k 94½	95	98
West Va. Utilities, 7% pf.—50.	k 49	43	51
Western Pwr., 7% pf.	97	97	98
Western States Gas & Elec., 7% pf.	93½	89	94½
Western States Gas & Elec., com.	17	....	....
Westinghouse Elec. & Mfg., 8% com. —50	70½	65	79½
Weston Elec. Instrument, Cl. A $2.01 —no par.	k 31½	27½	32½
Weston Elec. Instrument, com.—no par.	15½	13½	19½
Wheeling Elec., 6% pf.	k 95	91	97
Wis. Pwr., Lt. & Ht., 7% pf.	k 95	85	91
Worthington Pump, 7% pf. A	48	44	80
Worthington Pump, 6% B.	k 40½	37½	65
Worthington Pump, com.	23½	19	44½
YADKIN RIVER PWR., 7% pf.	l107½	107½	107½
Yale & Towne, com. $5—25.	71½	60½	72½

Stock Exchange: aChicago; bSt. Louis; cPhiladelphia; dBoston; eBaltimore; fMontreal; gCincinnati; hSan Franisco; iPittsburgh; jWashington. kBid price Saturday, Jan. 8. lBid price Wednesday, Jan. 12. mLatest quotations available. *1927. †Dividend rate variable.

First lien 5½ per cent gold bonds of the People's Light & Power Corporation were offered during the week under review to the amount of $6,500,000, the price being 97 and interest to yield over 5.80 per cent. These first lien bonds will, in the opinion of counsel, be the direct obligations of the corporation and, with the $5,600,000 principal amount first lien bonds now outstanding, will be secured by the pledge and deposit of all of the outstanding bonds and capital stock, except directors' shares, of the present constituent companies and the companies to be presently acquired, constituting upon completion of this financing the only secured debt of the corporation and its constituent companies outstanding in the hands of the public.

The Central Arizona Light & Power Company issued first and refunding mortgage 5½ per cent gold bonds, series C, to the amount of $1,300,000, the price being 100 and interest, and the General Power & Light Company issued one-year 6 per cent gold notes amounting to $750,000, the price being 100 and interest.

The Florida Public Service Company issued first mortgage 6 per cent gold bonds, series B, in amount of $1,684,000, at 100 and accrued interest.

Increase in the working capital of the National Pole & Treating Company and retirement of a part of its floating debt will be effected with the proceeds of an issue of $2,000,000 of the company's five-year 6 per cent notes which were offered during the week under review. The price of the notes, which mature Dec. 1, 1931, was 99 and interest, yielding about 6.25 per cent. The company has acquired among others the principal assets of the National Pole Company and the Northern Tie & Treating Company, which were well established and successful operators in the field of business in which the present company will further its operations, namely, the purchase, treating and sale of forest products.

Extra Dividends. — The Eureka Vacuum Cleaner Company has declared a 10 per cent stock dividend, 5 per cent of which is payable March 1 to stock of record Feb. 18, and 5 per cent payable at the time of regular dividend on Aug. 1, 1927. Directors also declared an extra dividend of 25 cents and the regular quarterly of $1, payable Feb. 1 to stock of record Jan. 20.

Winnipeg Company Closes Successful Campaign.—The second customer-ownership campaign of the Winnipeg Electric Company, Winnipeg, Man., proved a remarkable success. The sale of 2,500 shares of the company's 7 per cent cumulative preference stock opened on Dec. 13 and was advertised to con-

tinue for ten days, but so great was the demand for the shares that the sale closed within 48 hours with 11,377 shares ($1,137,700) applied for by 2,222 customers.

Thirty-Million-Dollar Issue Approved

The Indiana Public Service Commission has approved the issuance of $30,000,000 of 5 per cent thirty-year first mortgage bonds, 120,000 shares of 6½ per cent preferred stock and 600,000 shares of no-par common stock to enable the Indianapolis Power & Light Company to acquire the Indianapolis Light & Heat Company and the Merchants' Heat & Light Company.

The bonds are to be of an authorized issue without limit as to maximum amount in the aggregate and may be subject to redemption at not exceeding 105 per cent of the principal amount. The 6½ per cent cumulative preferred stock of the par value of $100 per share entitles the holders to cumulative dividends at the rate of 6½ per cent per annum, payable semi-annually or quarterly, and may be subject to redemption at not exceeding 115 per cent of the par value.

New Haven Company to Issue Stock to Stockholders. — The United Illuminating Company, New Haven, Conn., will increase its capital stock $2,000,000. The additional stock is made possible by adding one share for every nine shares outstanding at $37 a share. At present there are 509,000 outstanding no-par-value shares, and in excess of 56,000 shares will be added, the proceeds of which will be used for extensions. Payments will be on the deferred plan and the stock will yield 6 per cent interest. A payment of $7 a share is scheduled for February, another of $10 in October and other payments of $10 come in April, 1928, and October, 1928. Stockholders of record Dec. 20 have the privilege of taking up the stock.

Long Island Lighting to Increase Capital.—A special meeting of stockholders of the Long Island Lighting Company has been called for Jan. 19 for the purpose of increasing the authorized capitalization by $10,000,000. The new capital will be in the form of cumulative preferred stock, to consist of 100,000 shares of a par value of $100 to be issued in one or more series and in such number of shares and at such dividend rates, not exceeding 7 per cent per annum, for each series as the board of directors may determine.

Shawinigan Shareholders Vote to Split Shares.—The shareholders of the Shawinigan Water & Power Company have unanimously ratified a bylaw previously adopted by the directors providing for the conversion of the shares of the company into shares without par value on the basis of four shares without par value for each share of the par value of $100. When this bylaw has been confirmed by the provincial government, each registered holder of a share of the presently issued capital stock of the company will be deemed to be the holder of four fully paid shares without par value, and the presently issued 275,000 shares of the par value of $100 each will be changed into 1,100,000 shares without par value. Under the bylaw the remainder of the authorized and unissued shares of the company will also be changed into shares without par value on the same basis of four for one.

Massachusetts Utility Changes Capital Set-up.—The United Electric Light Company, Springfield, Mass., has voted to split up the stock of the company. Under the plan shareholders will receive four shares of stock at a par value of $25 for each present share at $100 par value. A regular quarterly dividend of $3 a share and an extra dividend of $3 a share, the latter amounting to $120,000, were declared. Customers will also share a dividend. A sum equal to 25 per cent of the January bill will be deducted from each customer's account. The company has also announced the election of Lorenze Scott, superintendent and general manager, to the board of directors to fill the vacancy left through the death of Robert W. Day.

Hydro and Steam Differential Lower

Operating Costs in Both Types of Electric Generating Plant Show Reduction Over Five-Year Period

THE operating differential which hydro-electric plants enjoy over steam plants appears to be growing smaller. Costs per dollar of gross show a greater decline over a five-year period in steam than in water-power plants. Analyses of representative groups of hydro-electric and steam plants made by the ELECTRICAL WORLD show that the operating costs have declined more or less steadily during the past few years. In the case of steam plants the average operating ratio of ten representative plants in 1921 was 68; in other words, 68 cents out of every dollar of gross went toward the cost of operation. This average declined steadily until 1925, when it was 61. Figures not yet completed for 1926 indicate a further reduction. In the case of hydro-electric plants the operating ratio was 44 in 1921. With the exception of 1924, which was an abnormal year and in which the ratio increased to 46, a steady decline has taken place. A comparison of the two sets of ratios shows a slightly greater percentage of reduction in the steam than in the hydro plants. Figures for the two series follow:

Years	Steam Operation	Hydro Operation
1921	68	44
1922	67	42
1923	65	42
1924	62	46
1925	61	40

The wide variation which exists between the essential costs in hydro-electric and in steam operation is illustrated in the following table showing the percentages of the various items in the groups studied:

Per Cent Distribution of Costs

	Steam	Hydro
Operating cost	70	49
Depreciation	8	11
Taxes	11	12
Interest	11	28
	100	100

Percentage of Gross Revenue

	Steam	Hydro
Operating cost	57	38
Depreciation	7	9
Taxes	8	10
Interest	9	21
	81	78

As shown in the table, the greatest diversity between steam and hydro operation exists in actual operating costs and in interest requirements. In the former steam plants require 70 cents out of every dollar of gross and in the latter only 49 cents. Naturally, there is a much larger percentage of the total required for interest charges in the case of hydro-electric plants, in view of the heavy original costs. This item, however, has shown a decrease, owing to the gradual reduction in interest rates on bonds and the wholesale exchange of old issues for new at a lower coupon rate. This factor, of course, tends to increase the differential between the two types of plant.

Turning to the percentage which the various items bear to gross earnings, it is apparent that a larger surplus is made available after necessary costs in hydro than in steam plants. In the case of the former operating costs require 38 cents and in that of the latter 57 cents out of every dollar of gross. The other three charges, especially interest, were larger in the case of hydro plants, but there was not sufficient difference to bring the hydro total up to that of the steam plants. It stood at 78 against 81 in steam plants, which indicates a margin available for surplus and dividends at 22 per cent in hydro plants against 19 per cent in steam operations.

PROPORTION OF INVESTMENT IN COSTS

Another striking variation between hydro and steam plants is found in the percentage which each bears to total investment. In the case of the ten steam plants gross revenue amounted to 23 per cent of the fixed capital investment against 12 per cent in the case of the hydro-electric plants. Operating costs in the steam plants were 14 per cent against 5 per cent in the hydro-electric plants. Depreciation costs and taxes were about the same proportion, while interest charges were slightly higher in the case of hydro plants.

In considering the above differences between steam and hydro operation, it should not be overlooked that hydro-electric costs vary less than steam-plant costs as a result of shifting price levels. In the former money price changes correspond to general commodity price changes in the latter.

Manufacturing and Markets

Electrical Exports Steady—Tendency to Increase

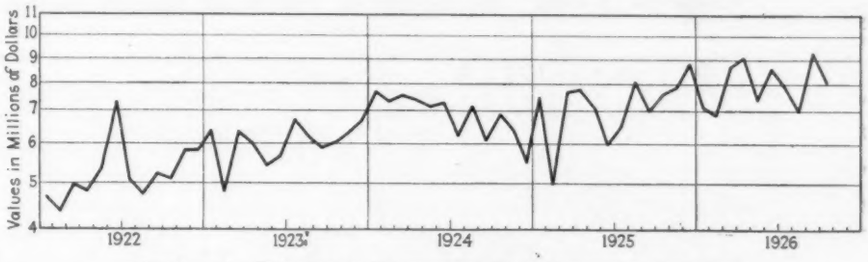
Competition Between the Three Leading Manufacturing Countries Extremely Strong—Wire and Porcelain Largest Exports

EXPORTS of electrical apparatus in the United States reached the highest figure in 1926 for any year since 1921. It is estimated that the total value will reach $96,000,000 for the year. Of this amount wire predominates and is the largest class of exports, amounting to approximately 15.4 per cent of the total, and motors and control equipment form the second class, with a total value of approximately 11.6 per cent. Our exports of radio are third on the list and represent 11.3 per cent of the total, while transmission and distribution material, not including transformers, come fourth and amount to 9 per cent of the total exports. Generating equipment, wiring devices, batteries and transformers are exported to a value in the order mentioned, ranging from 6 per cent for generating equipment to approximately 5 per cent of the total for transformers.

MARKET TREND

The curve for monthly exports shows a comparison of our electrical exports by months for the past five years. This curve shows that our export business for the year 1926 was higher than that for 1925, with a slight upward tendency in the monthly figures, although the upward trend is not so marked as in the year 1923. The variation in the values of the monthly exports was very much less in 1926 than in the years previous, averaging approximately $8,000,000 per month. It is quite apparent from the general trend of this curve that although our electrical exports now show an upward trend, at the same time this trend is considerably less than it was during the recovery period directly after the post-war slump. This lower rate of increase is due almost entirely to our competi-

(*Continued on page* 177)



EXPORTS OF ELECTRICAL MACHINERY, EQUIPMENT AND SUPPLIES FROM THE UNITED STATES

Curve indicates the rate of change

Value of Electrical Exports for 1925 and for Ten Months of 1926 Compared with Same Period in 1925

(Compiled from data issued by Bureau of Foreign and Domestic Commerce)

Articles	Year 1925	Ten Months 1925	Ten Months 1926
Generators:			
Direct-current.			
Under 500 kw.	$847,697	$663,487	$765,045
500 kw. and over	427,857	341,461	424,583
Alternating-current:			
Under 2,000 kva.	324,325	273,492	262,210
2,000 kva. and over	1,879,774	1,299,426	975,571
Steam turbine-generator sets	564,779	486,361	788,449
Accessories and parts for generators	1,089,265	798,038	699,022
Self-contained lighting outfits	1,075,981	846,583	899,818
Batteries:			
Flashlight batteries	1,213,766	974,073	1,289,743
Other primary batteries	1,203,966	990,220	1,663,909
Storage batteries	2,681,288	2,215,619	2,798,216
Transforming or converting apparatus:			
Power transformers	2,175,206	1,816,808	1,696,727
Other transformers	1,315,469	1,120,326	1,042,108
Rectifiers, double-current and motor generators, dynamotors, synchronous and other converters	966,383	800,288	1,310,441
Transmission and distribution apparatus:			
Switchboard panels, except telephone	2,304,742	1,931,769	1,985,987
Switches and circuit breakers over 10 amp.	2,423,838	1,724,177	2,178,642
Fuses and fuse blocks	342,831	274,581	292,173
Watt-hour and other measuring meters	447,417	377,149	407,802
Volt, watt and ampere meters and other recording, indicating and testing apparatus	1,695,906	1,366,616	1,735,283
Lightning arresters, choke coils, reactors and other protective devices	707,299	592,046	580,355
Motors, starter and controllers:			
Motors, under 1 hp.	2,101,825	1,729,872	1,631,714
Stationary motors:			
1 to 200 hp.	2,472,418	1,891,302	2,678,587
Over 200 horsepower	604,022	487,697	806,923
Railway motors	807,537	746,049	987,573
Electric locomotives:			
Railway	481,666	189,566	1,753,926
Mining and industrial	330,655	290,914	581,052
Starting and controlling equipment:			
For industrial motors	1,159,011	904,368	1,154,578
For electric railway and vehicle motors	278,432	247,898	179,108
Portable electric tools	*	*	427,964
Accessories and parts for motors	2,039,607	1,710,935	1,852,858
Electric appliances:			
Electric fans	916,553	838,995	823,154
Electric lamps:			
Metal filament	1,250,357	1,039,216	1,339,397
Other electric lamps	243,739	205,076	217,368
Flashlights	$1,342,225	$1,060,977	$1,716,223
Searchlights and projectors	561,557	457,623	350,695
Motor-driven household devices	1,205,583	1,007,038	1,393,127
Domestic heating and cooking devices	1,339,799	1,091,788	1,318,089
Industrial electric furnaces and ovens	252,324	186,195	180,773
Therapeutic apparatus, X-ray machines, galvanic and faradic batteries, etc.	1,414,721	1,153,401	1,213,355
Signal and communication devices:			
Radio apparatus	9,903,787	7,559,505	1,552,838
Transmitting sets and parts	*	*	417,214
Receiving sets	*	*	2,049,336
Tubes	*	*	719,020
Receiving set components	*	*	1,511,262
Receiving set accessories	*	*	1,860,930
Telegraph apparatus	497,231	430,303	829,996
Telephone apparatus:			
Magneto telephones	124,575	100,642	87,874
Other telephones	497,765	422,446	286,442
Telephone switchboards	799,054	760,974	2,030,495
Other telephone equipment	2,298,018	2,021,317	2,101,990
Railway signals, switches, and attachments	803,446	687,846	420,100
Bells, buzzers, annunciators and alarms	171,017	146,143	249,890
Other electric apparatus:			
Spark plugs, magnetos and other ignition apparatus	2,708,142	2,288,705	1,681,707
Insulating material	1,544,911	1,296,525	1,187,181
Metal conduit, outlet and switchboxes	796,503	648,897	977,814
Sockets, receptacles and lighting switches	1,595,297	1,288,178	1,398,076
Electric lighting fixtures, interior and street	1,313,868	1,012,127	1,531,760
Other wiring supplies and line material	1,131,852	878,918	1,000,353
Other electric apparatus, not elsewhere stated	6,882,648	5,743,028	6,092,914
Rubber and friction tape	*	*	288,432
Globes and shades for lighting fixtures	494,947	410,235	490,686
Electrical glassware except for lighting	269,962	238,575	395,178
Electrical porcelain:			
For less than 6,600 volts	949,785	757,891	667,391
For 6,600 volts and over	702,417	615,861	688,885
Carbons, carbon brushes and electrodes:			
Electrodes for electric furnaces	1,213,754	890,539	1,398,096
Other carbon products	2,000,580	1,850,499	1,032,616
Insulated wire and cable (iron and steel)	268,155	229,712	216,171
Copper, bare wire	2,094,108	1,817,566	1,960,614
Copper, insulated wire and cable	4,900,264	3,720,316	4,111,615
Total electrical machinery and apparatus and supplies	$86,451,906	$69,948,178	$81,639,424

*Not separately stated prior to Jan. 1, 1926.

Decreased Production

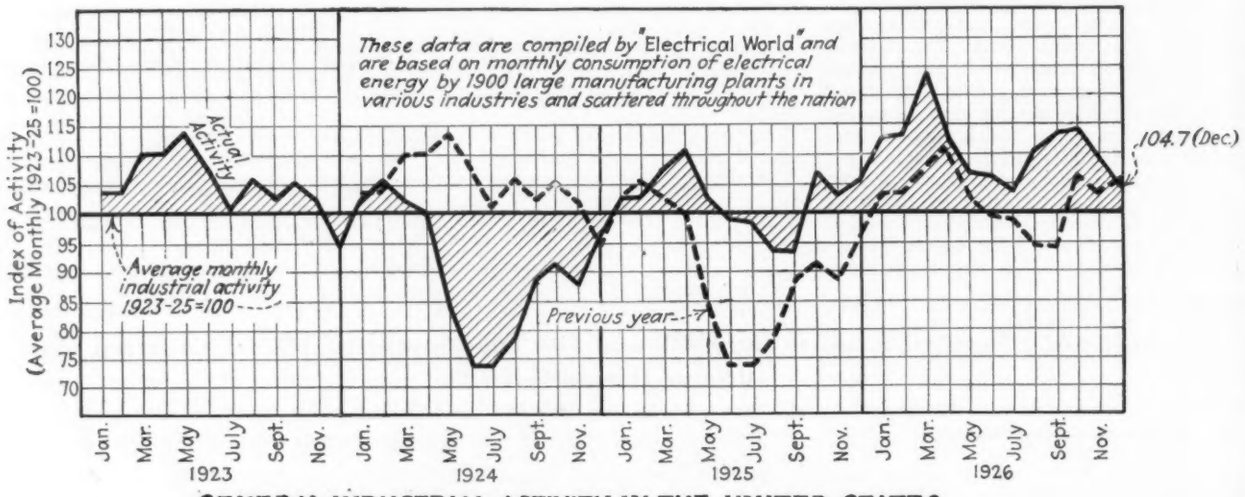
December Operations Slightly Under Those of the Month of December, 1925

FOR the first time in almost two years general industrial activity in the United States during December was under that for the same month of the previous year. Ever since February, 1925, the operations of the industrial plants of the nation have in each month been materially above those for the same month of the previous year. Owing to the downward trend in the activities of the automobile and lumber industries, however, the activities of general industry during December declined to a point below those of December, 1925. Such is the position of general industrial operations in the nation as a whole as indicated by reports received by the ELECTRICAL WORLD on the cosumption of energy by the manufacturing plants of the nation—plants consuming more than eight-billion kilowatt-hours per annum. During December general industrial productive operations were 2.6 per cent under those of November, even though November had two less working days than December. The operations during December were also slightly below those of December, 1925, but were 4.7 per cent over the monthly average for the three-year period 1923-25. The automobile industry operated during December at 7 per cent under November, and the lumber industry registered a drop of approximately 20 per cent under November. The metal industries operated at about the same rate as in November, as did also the textile industries. Operations in the "leather and its products" industry increased 6 per cent, December operations being the highest since October, 1925, and about 26 per cent over December, 1925.

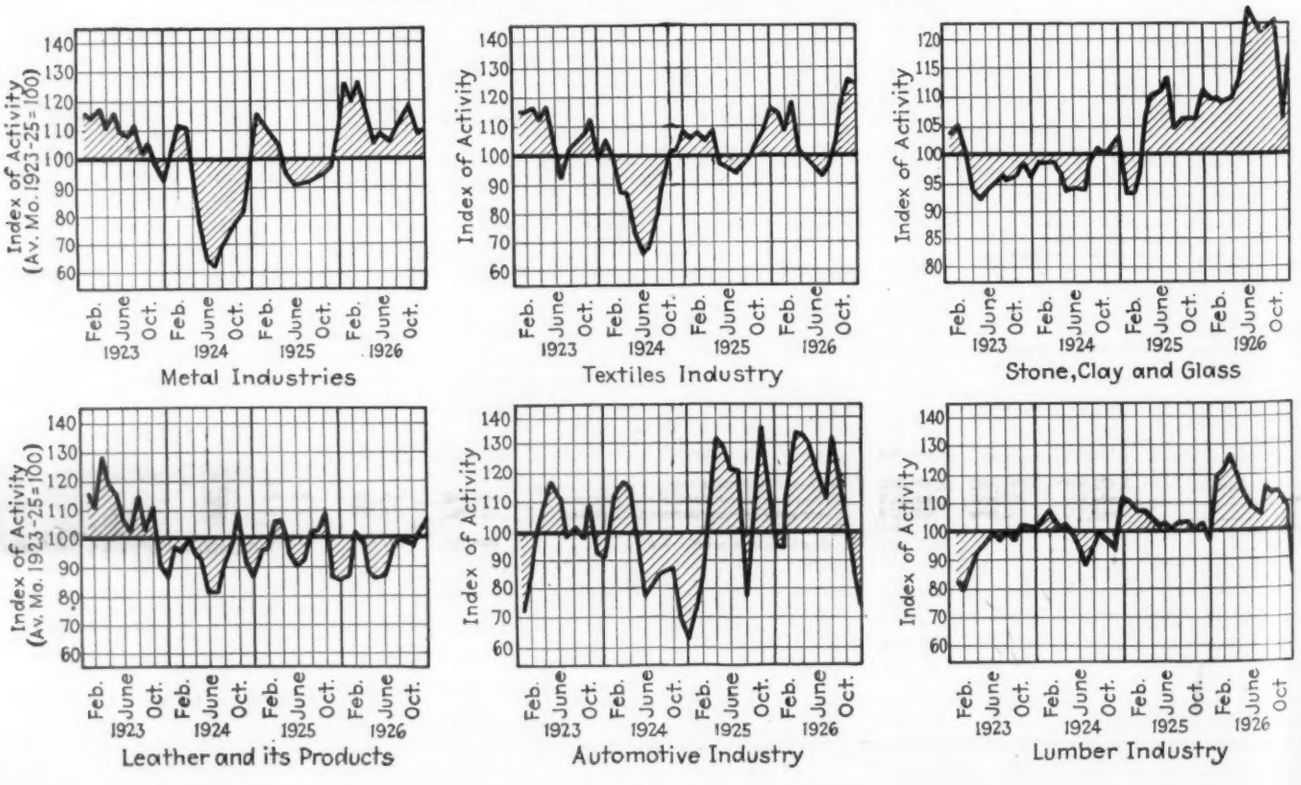
The year 1926, however, was without question the most prosperous year in the history of the American nation, and the operations of manufacturing plants far exceeded those of 1925. Many of the primary industries—such as the iron and steel, automobile, lumber and cement—have been turning in production reports which have never before been approached in the history of American industry, and virtually all of the primary industries, both large and small, have operated on a par with or above 1925.

"Electrical World" Barometer of Industrial Activity in the United States as a Whole

(Data Unadjusted for Seasonal Variation)


These data are compiled by "Electrical World" and are based on monthly consumption of electrical energy by 1900 large manufacturing plants in various industries and scattered throughout the nation
Index of Activity (Average Monthly 1923-25=100)
Actual Activity
Average monthly industrial activity 1923-25=100
Previous year
104.7 (Dec.)
Jan. Mar. May July Sept. Nov.
1923
1924
1925
1926

GENERAL INDUSTRIAL ACTIVITY IN THE UNITED STATES



Electrical Exports Steady—Tendency to Increase

(*Continued from page* 175)

tion from the other countries manufacturing and exporting electrical apparatus and supplies.

In picturing the position of the three leading manufacturing countries, the United Kingdom, Germany and the United States, in the electrical export field it has been necessary to use the 1925 figures, as these are the latest that can be obtained for the three countries; however, it is reasonably sure that the relative position of the countries did not change during 1926. In 1925 the United Kingdom was the largest exporter of electrical apparatus and supplies, exporting approximately $85,400,000, with Germany second, exporting $78,000,000, and the United States third, with a total of $73,790,000. (The figure of the United States is less than that shown on the curve of monthly exports because wire and electrical porcelain have been omitted, as these items were not included in the statistics for the two other countries.)

The United Kingdom led the three countries in the exports of electrical apparatus to non-manufacturing countries, her exports amounting to $72,000,000, as against Germany's $48,100,000 and the United States' $47,000,000. However, it is interesting to note that of this $72,000,000, $18,300,000 went to Australia and $10,660,000 to India—in other words, countries included as members of the British Empire. The German exports to non-manufacturing countries were very well diversified to all countries of the world, no particular country outstanding, whereas the United States' exports to non-manufacturing countries were principally to Australia, Cuba, Mexico, Argentina and Brazil, each of these countries taking between three and four million dollars' worth during the year. In other words, of the non-manufacturing countries outside of Australia, the Latin American countries offered our principal market for electrical goods.

Principal Markets

The principal markets for the United States' electrical exports are Canada and Japan, Canada taking $14,363,198 and Japan $10,110,974. The principal country of export for Germany was the Netherlands, with a value of $8,260,000, and the principal markets for the United Kingdom were India and Australia.

The economic conditions are such in both the United Kingdom and Germany that they have been forced to resort to virtually every means of competition in order to build up and to regain their former position in the export field. In many cases the competition has resulted in the export of apparatus at extremely low prices and in some instances of a class of material not up to the standard quality of that exported by this country.

This competition has also been greatly assisted in certain localities by investments of the nationals of our competitors in the public utility field, and this investment and control of course results in a considerable sale of machinery.

Electric Industrial Trucks and Tractors

October shipments of electric industrial trucks and tractors, as reported to the Department of Commerce by the nine leading manufacturers in the industry, were 123, as compared with 132 in October and 124 in November, 1925. The accompanying table shows the detailed figures by quarters for 1925 and by months since January, 1926.

SHIPMENTS OF ELECTRIC INDUSTRIAL TRUCKS AND TRACTORS

	Domestic		
1925 Quarter ended:	Tractors	All Other Types	Exports
March 31	45	259	41
June 30	49	280	50
Sept. 30	57	286	12
Dec. 31	41	295	25
Total	192	1,120	128
1926 Quarter ended:			
March 31	47	310	17
June 30	50	281	32
Sept. 30	39	258	8
January	21	86	4
February	15	96	5
March	11	128	8
April	17	90	4
May	12	87	9
June	21	104	19
July	15	95	1
August	14	81	2
September	10	82	5
October	18	*97	*17
November	18	86	19
Total, 11 months	172	1,032	93

* Revised

Business Conditions

ACTIVE business is reported by manufacturers in the industry. Orders for hydro-electric equipment and synchronous condensers placed in the South amounted to more than $1,200,000, and another order for waterwheel units on the Pacific Coast involved an expenditure of $130,000. Contracts were also let for more than $1,500,000 worth of lead-sheath paper-insulated cable by a utility company in the Middle West. An electrification scheme in Poland involving an outlay of nearly $25,000,000 will culminate at an early date. A fan and blower equipment manufacturer reports that prospects and sales indicate a good business in the spring throughout the country. Unfilled business of the United States Steel Corporation increased 153,522 tons during December, which brings the total of unfilled orders on Dec. 31 to 3,960,969 tons.

In New England buying continues steady, with few large orders. Motor sales dropped, but compare favorably with those of the previous week, and electric welding equipment is active. Substation apparatus is active in the New York district and a number of inquiries are in the hands of manufacturers. General-purpose motors are finding a good market, and the demand for control apparatus is improving. In the Southeast a large central-station order was placed and activity of textile mills is pronounced. Construction of high-tension lines is also stimulating the market. The volume of sales continues steady in the St. Louis district, while in the Middle West some large orders were placed by utility companies. On the Pacific Coast buying shows an improved trend.

Copper Market Improves—Lead Sales Also Increase

Copper sales have shown considerable improvement, both here and abroad, at somewhat higher prices. Lead has also sold in satisfactory volume. The Middle West has bought copper to some extent, but most of the business has been placed with brass and wire mills in the East. The American Smelting & Refining Company reduced its official contract price for lead to 7.65 cents. The present price is now on a parity with the lowest figure quoted last year. The bulk of the buying was for prompt and January delivery. Zinc sales have compared well with those of recent weeks, and the demand for tin was quiet at unchanged prices.

NEW YORK METAL MARKET PRICES

	Jan. 5, 1927 Cents per Pound	Jan. 12, 1927 Cents per Pound
Copper electrolytic	13¼	13¼
Lead, Am. S. & R. price	7.80	7.65
Antimony	12½	13¼
Nickel, ingot	35	35
Zinc spots	7.25	7¼
Tin, Straits	66¼	67¼
Aluminum, 99 per cent.	27	27

Base copper price Jan. 12, 1927, 15¼ cents.

Large Central-Station Order Placed in Southeast

Interesting orders placed in the Southeast covered four hydraulic turbines and generators amounting to more than $1,000,000 and condensers totaling $200,000. Inquiries from industrial plants are reported in satisfactory number, with textile mills the most active. An addition to a textile mill in Georgia will require about $30,000 worth of electrical equipment. A new textile mill in this territory will also let contracts within the next ten days for construction and equipment for the mill. Electrical materials for this mill will cost approximately $75,000, and the construction of 400 houses in the mill village will call for additional wiring material. Several orders ranging from $5,000 to $10,000 each were received from textile mills last week.

The small-motor market is better than in some months past, and indications are for sustained activity. Construction of high-tension lines is stim-

ulating the motor market, house-wiring activities and appliance sales, though at the present time few appliance orders are reported by jobbers. A large jobber reports an increase in his business of 13 per cent, as compared with 1925, despite a decrease of about 20 per cent in radio lines. Supply lines showed an increase of about 25 per cent.

Steady Buying Continues in New England District

Steady buying continues in the New England district, but few large orders of special interest are noted. Small-motor sales dropped in volume as compared with the previous week, but continue quite favorably. Prospects for fulfillment of the district allotments as set by the various manufacturers of small motors appear good. Electric welding equipment is in active demand, with a sales increase of over 50 per cent in the district during 1926 as compared with 1925, according to one manufacturer, and negotiations in good volume are also being conducted. Street-lighting projects are taking on definite form, and quotations are asked for a number of eastern Massachusetts plans. Electric commercial cooking equipment shows a strong upward trend. A prominent central-station company records a number of cooking units recently placed, among which should be noted a bread-baking oven and broiler units amounting to over $5,000. Domestic range sales are active, and a 10 per cent gain in volume is noted for this district by one central-station company.

Utility Companies Place Large Orders in Middle West

Business in the Middle West is universally good. Industrial activity continues strong, with relatively small stocks on hand, and building activity shows every indication of equaling last year's record. Utility companies continue with construction work, and quite a little purchasing of apparatus was recorded. Among the interesting orders placed was one valued at $280,000 for a complete condensing equipment with appurtenances for a 104,000-kw. turbo-generator, another for four 13,000-amp., 225-volt synchronous booster converters and appurtenances, while orders were also placed for 180 carloads of lead-sheath paper-insulated cable valued at more than $1,500,000. There has been a good demand for cross-arms, insulators and pole-line hardware. Jobbers report a normal amount of business.

Buying Shows Improved Trend on Pacific Coast

Business on the Pacific Coast continues markedly better. Power-apparatus sales included an order for $4,000 worth of automatic feeder-reclosing equipment and $3,000 worth of feeder regulators for the San Francisco Bay district. Additional plant equipment purchased by a central-station company covered an 8,000-kva. waterwheel unit, four transformers, each 4,000 kva., and wiring material totaling $130,000. Railroad and industrial-plant purchasing of supplies has been good. School and hospital work in the Bay region is reported to be particularly good.

Sales have been light in the Seattle district, although several individual orders for single motors were placed. A 300-hp. motor was sold to a Seattle lumber mill and eight units of from 20 hp. down to a lumber plant at Renton, Wash. A 150-ton paper plant is planned for Aberdeen, Wash. The demand for pole-line materials is much better, and heavy buying of such material is anticipated in the spring. The city of Seattle is taking bids for 50,000 lb. of No. 2 and No. 4 solid copper wire, and specifications are also expected to be ready in February for a 20,000-kw. downtown transformer substation at Spring Street.

Substation Apparatus Active in New York District

Large numbers of inquiries are being received by manufacturers for quotations on transformers and substation apparatus, and an increase in the volume of orders for this material is reported in the New York district. An increase in activity is noted in other lines, although no great number of sales is reported for switching equipments, circuit breakers or similar equipment. Poles and cross-arms are in good demand, although individual sales are small. General-purpose motors are finding a good market, and the demand for control apparatus is improving. Jobbers report a fair demand for conduit, fittings, etc., but appliance sales are dull.

Volume of Sales Continues Steady in St. Louis District

Sales in the St. Louis district continue to show neither gain nor loss. A motor manufacturer reports that he is producing 1,000 motors of ¼ hp. to ½ hp. on a contract with a manufacturer of electric refrigerators. Inquiries are being received from central-station companies for material for extensions planned for the coming season. An order has been placed for transmission-line material amounting to about $4,000 to get to a central-station company in southeast Missouri. Another order for medium-sized motors, aggregating $2,000, has been shipped to an industrial concern in the northern part of the district. The largest sale reported was for $30,000 worth of motors, in sizes from 5 hp. to 75 hp., for use in effecting the complete motorization of a large paper-box factory in Alton, Ill.

Activities of the Trade

American Brown Boveri Sells Rectifiers to Connecticut Company

The Connecticut Company has ordered from the American Brown Boveri Electric Corporation, 165 Broadway, New York, mercury-arc rectifiers and all auxiliary equipment for its Bridgeport and Stratford 600-volt traction-service substations. The Bridgeport installation will comprise five manually controlled units aggregating 6,000 kw., and the Stratford substation will employ two full-automatic units totaling 2,400 kw. All equipment is designed for operation at 13,900 volts, 60 cycles; 11,400 volts, 25 cycles, or 6,600 volts, 60 cycles, and the shifting from one source of supply to another may be accomplished without any appreciable equipment change.

Two Westinghouse Subsidiaries Become Branch Works

The corporate form of two subsidiaries of the Westinghouse Electric & Manufacturing Company has been discontinued, and the companies are now merged into the parent company as branch works. The companies affected are the Westinghouse Electric Products Company of Mansfield, Ohio, and the George Cutter Company of South Bend, Ind. In the future they will be designated as the Mansfield works and the street-lighting department, respectively, of the Westinghouse Electric & Manufacturing Company. The latter department will include not only the South Bend works, which is one of the largest in the country devoted to the manufacture of street-lighting equipment, but also the branches for the manufacture of poles of the "hollowspun" type in Milwaukee, St. Louis and Valdosta, Ga. The Mansfield works are devoted to the manufacture of domestic electric appliances, including electric ranges and ovens and safety switches.

Electric Refrigeration Reports Less Seasonal Variation

In the first annual report of the Electric Refrigeration Corporation, Detroit, A. H. Goss, president, states that the development of the electric refrigeration industry has been very rapid during the last nine months and that it is showing a tendency to become less seasonal in character, although it is anticipated that a far greater domestic demand will occur during the first six months of each year than during the second six months.

"The larger the export business of the company becomes," said Mr. Goss, "the less seasonal variation will be experienced in sales." Referring to the company's export business, Mr. Goss said further: "The directors felt that the best interest of the company in the proper handling of its export business would be served by a separate Canadian corporation." Accordingly, Kelvinator of Canada, Ltd., at London, Ontario, was organized, and an agreement was entered into with the United Refrigeration Corporation whereby it would handle its export business. The Electric Refrigeration Corporation owns 74 per cent of the stock of the Canadian

corporation. Mr. Goss further reports that the demand for the company's products during the heavy selling period of the year 1926 taxed the capacity of the plant facilities, which are now being enlarged, as reported in the July 31, 1926, and August 7, 1926, issues of ELECTRICAL WORLD, and the company is looking forward to greatly increased sales in 1927.

A complete statement issued by the corporation for the nine months ended Sept. 30, 1926, shows a consolidated net profit of $2,622,652 after deduction of charges and federal taxes. The above statement includes earnings of the Refrigeration corporation and subsidiaries, with the exception of the Refrigeration Discount Corporation (100 per cent owned) and Kelvinator of Canada, Ltd., 74 per cent of the common stock of which is owned by the Refrigeration corporation.

American Brown Boveri Estimates 1927 Sales at $35,000,000

In a statement issued by Laurence R. Wilder, president of the American Brown Boveri Electric Corporation, 165 Broadway, New York, it is predicted that sales of the company during 1927, based on business in hand and in sight, will reach $35,000,000. Orders received by the company and its subsidiaries during 1926 are estimated at approximately $25,000,000.

Coldak Corporation Consolidates with Alaska Refrigerator

Consolidation of the Coldak Corporation, New York, manufacturer of "Coldak" electric refrigerating machines, with the Alaska Refrigerator Company of Muskegon, Mich., has been announced coincident with the election of A. P. de Saas as president of the Alaska Refrigerator Company, succeeding A. B. Cunningham, who has retired. Mr. de Saas is vice-president of the Coldak Corporation, whose activities are directed by the J. G. White Management Corporation. The other officers of the Alaska company continue in their respective positions, and the executive offices will remain in Muskegon. Mr. de Saas said that the Alaska company will begin at once to manufacture boxes for Coldak, but will continue with its present line of ice chests. He further expressed the conviction that 1927 will bring increased business for the refrigeration industry.

European Refrigerator Market Rapidly Developing

Rapid development of the European market for the electric refrigerator is reported by R. D. Funkhouser, president of the Frigidaire Corporation, Dayton, Ohio, who has just returned from Europe. Announcement has also been made of the opening of new sales branches in Nice, France, and Birmingham, England, as well as the appointment of distributors in Budapest, Vienna, Bucharest, Stockholm and Geneva. Branches are also being projected for Manchester, Liverpool, Glasgow and Edinburgh. As a result of its confidence in the future of electric refrigeration abroad, General Motors, of which Frigidaire is a subsidiary, will spend many times as much in 1927 as it did in 1925 in promoting electric refrigeration in the foreign field. Sales records for 1926 showed an increase of fivefold over the preceding year, and this figure will be doubled in 1927, according to Mr. Funkhouser's predictions.

Estimates of Westinghouse Show Large Third-Quarter Sales

Orders booked by the Westinghouse Electric & Manufacturing Company for the quarter ended Dec. 31 are estimated at approximately $49,825,000, which compares with $39,770,000 in the corresponding quarter of 1925, and represents a gain of about 25 per cent. New business in the nine months ended Dec. 31, 1926, are estimated at $135,700,000, against $127,488,000 in the same nine months of last year, a gain of about 8 per cent. The company's fiscal year ends on March 31, 1927. Bookings for the full twelve months are estimated at $180,000,000.

Morgan Smith and Westinghouse Get Alabama Power Orders

Contracts for the major equipment for the Lock 18 development of the Alabama Power Company, Birmingham, were placed by that company last week. Four 36,000-hp. Francis type hydraulic turbines with Woodward governors and cast-iron runners were ordered from the S. Morgan Smith Company, York, Pa. Four vertical generators with direct-connected exciters and accessories, each having a rating of 29,000 kva. at 86.2 per cent power factor, were also ordered from the Westinghouse Electric & Manufacturing Company. Shipment of the first unit is to be made by Dec. 1, 1928, and the last unit is to be shipped by March 1, 1929.

Radio Corporation Sales in 1926 Estimated at $60,000,000

Sales of the Radio Corporation of America, Woolworth Building, New York, are estimated to be approximately $60,000,000 for the year 1926. This will make 1926 the best year in the history of the company. Business in 1925 reached a volume of $50,405,144. It is anticipated that the recent formation of the National Broadcasting Company, Inc., will have a large bearing on accelerating the Radio corporation's development.

The Industrial Electric Motor & Tool Company, 1 Howard Street, New York City, jobber of motors, blowers, compressors, pumps and electrically driven utility tools, announces that Alvin S. Rich, formerly with the Wagner Electric Corporation, is now connected with the New York branch of the company.

The Transelectric Company, selling Lapp insulators and Transelectric tools in the Chicago territory, announces the removal of its office from 360 North Michigan Avenue to larger quarters at 140 South Dearborn Street.

Walter D. Graham, 4421 West Carroll Avenue, Chicago, is offering a new line of electric body-warming appliances, including the new Graham electric health blanket and the new Graham electric sleeping-porch blanket.

The Conlon Corporation, Nineteenth Street and Fifty-second Avenue, Chicago, manufacturer of domestic electric washing and ironing machines, announces that since Jan. 1 it has placed a new washing machine on the market known as the Conlon "Gurgitator" washer, which is said to contain a number of improvements.

General Plastics, Inc., manufacturer of "Durez," a synthetic plastic molding compound, announces the opening of a New York office at 250 Park Avenue, with Lowell P. Weicker as manager.

New Equipment Available

Pyrometer

A radiation pyrometer, known as the "Pyro" instrument and utilizing an objective lens of clear quartz, has been placed on the market by the Pyrometer Instrument Company, 74 Reade Street, New York City. The lens, though only about 45 mm. in diameter, concentrates sufficient radiant energy on the thermocouple to develop forces fully as great as those developed by actual immersion of base-metal thermocouples at similar temperatures. The radiation thermocouple employed in this pyrometer consists of an extremely thin wire attached to a thicker supporting wire, a receiving disk being fixed over the joints for better receptivity of the radiation. The whole couple is then mounted in an evacuated glass bulb and adjusted in the axis of the optical system. The instrument is of the fixed-focus type. The distance factor of the average instrument is between 24 and 30, depending on the temperature range. Temperature readings can be obtained very speedily and in the instrument the millivoltmeter, thermocouple and optical system are incorporated in a single unit.

Starting Switch for Small Motors

An across-the-line starting switch which provides the advantage of push-button operation, thermal overload relays and no-voltage protection for motors up to 1½ hp. has been placed on the market by the Allen-Bradley Company, 286 Greenfield Avenue, Milwaukee.

The switch is known as the type J-1552 and is available in three forms. The form B-1 switch is equipped with start-and-stop push-buttons in the switch cover, the form B-2 switch is without push-buttons, and the form B-3 switch has a two-way lever switch for automatic and hand control. These switches measure approximately 8 in. high, 6 in. wide and 4¼ in. deep.

New Trade Literature

TACHOMETER.—Herman H. Sticht & Company, 13 Park Row, New York City, are distributing bulletin No. 225, describing the "Standco" pocket-size tachometer. Directions for using the tachometer for various purposes are included.

COMBUSTION CONTROL. — "Machine Regulation of Pulverized-Coal-Fired Boilers" is the title of bulletin No. 31 issued by the Smoot Engineering Corporation, 136 Liberty Street, New York, in which it describes the operation of pulverized-coal-fired plants and demonstrates the importance of machine regulation of coal, air and feed water. It also contains charts and illustrations of recent installation in various power plants. A diagram shows Smoot control applied to pulverized-coal-fired boilers, and specifications covering a combustion control system are included.

FANS AND BLOWERS.—The American Blower Company, Detroit, has issued bulletin No. 8,001, covering the "Sirocco" fans and blowers. A detailed description of the "Sirocco" fan and blower and various parts is given, and tables showing the capacity of the various types of "Sirocco" fans are included.

COAL PULVERIZERS.—Bulletin No. 36 issued by the Aero Pulverizer Company, a subsidiary of the Power Specialty Company, 111 Broadway, New York, describes the "Aero" unit coal pulverizers for firing pulverized coal. It contains a short sketch of the unit system for firing pulverized coal since it was placed on the market 25 years ago. Illustrations showing a number of installations in various plants are included.

DYNAMOMETERS.—The General Electric Company, Schenectady, N. Y., is distributing bulletin GEA-544 covering the General Electric dynamomters adapted for testing both high-speed and low-speed apparatus. The bulletin calls attention to the manifold uses of dynamometers, including engine tests, fuel distribution, lubrication.

GRAPHIC INSTRUMENTS.—The Esterline-Angus Company, Indianapolis, Ind., has issued catalog No. 406 covering the Esterline-Angus graphic instruments. It contains a short sketch of the organization, the growth of the graphic idea, essential features of its graphic instruments, special features and attachments, accessories for use with graphic meters, etc. Detailed specifications cover the complete line of instruments made by the company.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

Purcchase and agency are desired in Amsterdam, Netherlands (No. 23,443), for electrical household appliances.

An agency is desired in Delhi, India (No. 23,454), for electrical household appliances and wiring supplies.

An agency is desired in Tallinn, Esthonia (No. 23,432), for radio accessories and loud speakers.

Purchase and agency are desired in Bologna, Italy (No. 23,510), for radio sets and parts; also for same under (No. 23,511).

An agency is desired in Melbourne, Australia (No. 23,456), for radio tubes and neutrodyne kits for 200 and 1,500 meters.

Purchase is desired in Asuncion, Paraguay (No. 23,512), of wiring fixtures and supplies.

Purchase and agency are desired in Brussels, Belgium (No. 23,491), for electrolytic copper and other non-ferrous metals.

An agency is desired in Bombay, India (No. 23,541), for flashlights and electric household devices; also radio sets and parts (No. 23,540).

An agency is desired in Lambersart, France (No. 23,543), for radio sets and parts.

Purchase is desired in Barcelona, Spain (No. 23,584), of radio sets and parts.

An agency is desired in San Juan, P.R. (No. 23,542), for electrical refrigerators.

Purchase and agency are desired in Rosario, Argentina (No. 23,588) for electrical wiring supplies.

An agency is desired in Hamburg, Germany (No. 23,546), for internal-combustion engines and accessories. Purchase or agency is desired (No. 23,585) for sewing machines, vacuum cleaners and washing machines.

An agency is desired in Rio de Janeiro, Brazil (No. 23,550), for refrigerating machines.

An agency is desired in Berlin, Germany (No. 23,545), for measuring instruments.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

SALEM, MASS.—Plans are being prepared by C. H. Tenney & Company, engineers, 200 Devonshire Street, Boston, for an addition to the plant of the Salem Electric Lighting Company, to cost about $40,000.

PAWTUCKET, R. I. — Extensions and improvements are contemplated by the Blackstone Valley Gas & Electric Company during 1927, to cost about $1,229,000.

NORWICH, CONN. — The Connecticut Company, New Haven, has engaged R. W. Foote, 185 Church Street, New Haven, to prepare plans for a local electric substation.

Middle Atlantic States

ALBANY, N. Y. — An addition to the power plant of the New York State Laboratories, Department of Health, on Scotland Avenue, to cost about $250,000, is under consideration.

BINGHAMTON, N. Y.—Plans are being prepared by the Binghamton Light, Heat & Power Company for a substation, in conjunction with an equipment storage and garage building. The entire project will cost about $200,000.

BROOKLYN, N. Y. — Bids will be received by the Quartermaster, Intermediate Depot, Brooklyn, until Jan. 19, for batteries, fuses, plugs, etc. (Circular 86.)

BROOKLYN, N. Y. — Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Jan. 18, for delivering electric ovens and percolators, main engine motors, insulating tape, etc., to the Navy Supply Department, Brooklyn, N. Y.

ILION, N. Y.—The Utica Gas & Electric Company has applied for permission to erect a transmission line in the village of Ilion under a franchise granted by the Village Board.

NEW YORK, N. Y.—Plans have been filed by the New York Connecting Railroad, Pennsylvania Terminal, New York City, for a substation on its right-of-way between Eighteenth and Nineteenth Avenues.

NEW YORK, N. Y. — The New York Central Railroad Company, New York, has plans to build a substation at Philipse Manor, to cost about $21,000.

PERINTON, N. Y.—Permission has been granted the Rochester Gas & Electric Company to extend its system in the town of Perinton.

SCHENECTADY, N. Y.—Bids will be received by the Quartermaster, Reserve Depot, South Schenectady, until Jan. 27, for five voltmeters and 47 lightning arresters (Circular 6).

HARRISBURG, PA.—The City Council contemplates extensions and improvements in the street-lighting system in River Park, south of Paxton Street.

OIL CITY, PA.—The Citizens' Light & Power Company, has applied to the Federal Power Commission for permission to erect a transmission line across Allegheny River.

PHILADELPHIA, PA.—Bids will be received by the Board of Commissioners of Fairmont Park, City Hall, until Jan. 18, for electrical supplies for 1927. Alan Corson is chief engineer.

PHILADELPHIA, PA.—Plans are being prepared by the Philadelphia Electric Company for a substation, at Twenty-fifth Street and Washington Avenue, to cost about $400,000. John T. Windrim, Commonwealth Building, is architect.

WARREN, PA.—Bids addressed to Dr. W. H. Mitchell, superintendent, will be received by the Board of Trustees, Warren State Hospital, Warren, until Jan. 20 for furnishing and installing three engines and generators, switchboard, electrical work, piping, foundations, feed water heater, etc. Specifications may be obtained from J. E. Woodwell, consulting engineer, 501 Fifth Avenue, New York City.

HAGARSTOWN, MD.—Work on the first unit of the municipal electric plant will begin immediately, and the remainder of the specifications of the plant will be issued on Jan. 15.

HIGHLANDTOWN, MD.—The Edward Katzinger Company, 1949 North Cicero Street, Chicago, plans to install electric power equipment in its proposed local branch tinware-manufacturing plant to cost about $500,000.

ROCKYMOUNT, VA.—The Bald Knob Furniture Company plans to install an electric plant for service at a proposed new factory unit. The cost of the entire unit is estimated at $200,000.

North Central States

HUDSON, MICH.—Franchises have been voted to the Southern Michigan Light & Power Company in the townships of Prairieville and Barry. Under these franchises the company will supply electricity in the villages of Prairieville, Hickory, Corners and Delton. Service will also be supplied to farmers residing along the proposed lines.

JACKSON, MICH.—Extensions and improvements are contemplated by the Consumers Power Company during 1927, to cost about $2,000,000.

CINCINNATI, OHIO.—The installation of ornamental lamps on portions of Western Avenue, Hoffner Street, Linn Street and Clark Street is under consideration. The plans call for standards mounted with single lamps.

CLEVELAND, OHIO—Bids will be received at the office of the Commissioner of Purchases and Supplies, Jan. 21 for ornamental parkway lamp standards for the Division of Light and Power.

OBERLIN, OHIO—The Ohio Electric Power Company has petitioned for authority to issue $26,000 in bonds, and $19,000 in capital stock, to finance the purchase of the property of the Coldwater (Ohio) Lighting Company.

CHICAGO, ILL.—Bids will be received by the Signal Corps Procurement District, Chicago, until Jan. 20, for telephone equipment, including relays, condensers, repeating coils, switchboard key levers, switchboard plugs, etc. (Circular 17); also for 1,000 wall telephones, 1,000 desk telephones, induction coils, receiver caps, etc. (Cricular 18).

DECATUR, ILL.—Bids will be received by the Sanitary District of Decatur, Linxweiller, Building, until Feb. 1 for equipment for sewage treatment plant as follows: Division (A) blowers; (B) switchboard; (C) oil filtering equipment; (D) air meter; (E) air filter; (F) aeration plates; (G) air heating equipment, and (H) dosing tank equipment. Pearse, Greeley & Hansen, 6 North Michigan Avenue, Chicago, are consulting engineers.

NILES CENTER, ILL.—The City Council has rejected all bids submitted for the improved lighting system in the Lincoln Avenue lighting district. New bids, it is understood, will be asked in near future. Consoer, Older & Quinlan, 140 South Dearborn Street, Chicago, are engineers.

BEAVER DAM, WIS.—Plans are under way by the Wisconsin Power & Light Company, Madison, to erect a 6,600-volt transmission line out of Beaver Dam on Highway 31 to serve farmers along the highway.

EAGLE RIVER, WIS.—Plans have been approved by the Light and Power Commission for rebuilding the Otter Rapids power dam on the Wisconsin dam.

MADISON, WIS.—The installation of an ornamental lighting system on portions of University Avenue and West Gilman Street is under consideration by the City Council.

MILWAUKEE, WIS.—Plans are being prepared by Eschweiler & Eschweiler, 210 Mason Street, for construction of an administration and other buildings, power plant, etc., on North Avenue, to cost about $350,000, for the House of Good Shepherd, 5,100 North Avenue.

PORTAGE, WIS.—The Wisconsin Power & Light Company, Madison, plans to erect a transmission line between Fall River and Rio to serve electricity to the latter town and surrounding territory.

RACINE, WIS.—Steps have been taken by the Downtown Business and Professional Men's Association for the installa-

tion of an ornamental lighting system on Main and Sixth Streets. The plans call for standards mounted with lamps of 1,500 and 2,300 cp. The City Council is considering petitions for the installation of ornamental lamps on Center Street from Sixth to Twenty-first Street and on Franklin Street from Twelfth to Twenty-first Street. Improvements and alterations will be made to the lighting system on North Main Street. New lighting systems are proposed for the business districts of Racine Junction and West Racine.

STURGEON BAY, WIS.—The Municipal Electric Light Department is considering the erection of a transmission line, 4 miles long, to serve the government buildings and canal settlement, located near here.

WILD ROSE, WIS.—The Village Council has voted to install an ornamental lighting system. Street-lighting service is supplied by the Wisconsin Power & Light Company, Madison.

AUSTIN, MINN.—An extension of the ornamental lighting system to the East Side is under consideration by the City Council.

MOORHEAD, MINN.—The City Council has adopted a resolution to furnish current and maintain an ornamental lighting system on Center Avenue, First Avenue N, Seventh Avenue and Eighth Avenues, providing the property owners will pay for the installation of the poles and fixtures.

CRESTON, IOWA—The Iowa Southern Utilities Company, Centerville, is planning to rebuild its local power plant, recently damaged by fire.

VINCENT, IOWA—The town has voted to sell the municipal electric distribution system to the Central Iowa Power & Light Company, with a franchise allowing it to build and maintain a system in the town.

BOTTINEAU, N. D.—The Otter Tail Power Company, Fergus Falls, Minn., which has acquired the local electric plant, plans to extend and improve the system.

HUNTER, N. D.—The Hunter Power Company, recently organized by Alton F. Burgum, Hunter, and associates, plans to erect a transmission line from Arthur, to furnish service here.

CLINTON, NEB.—The Nebraska Electric Power Company, Davenport, Iowa, has applied for permission to erect a branch line (wooden poles) from its main transmission line between Gordon, Rushville and Hay Springs in order to serve Clinton.

LINCOLN, NEB.—Bids will be received by Adam McMullen, Chairman of the Nebraska State Capitol Commission, Lincoln, until Jan. 25 for lighting fixtures and equipment for the second section of the superstructure of the Nebraska State Capitol. Betram Grosvenor Goodhue Associates, 2 West Forty-seventh Street, New York City, are architects.

OMAHA, NEB.—Plans are under way by the Nebraska Power Company to erect a 66,000-volt transmission line from Omaha to Plattsmouth, a distance of about 20 miles.

Southern States

GREENSBORO, N. C.—Plans are being considered by the Southern Bell Telephone Company, Atlanta, Ga., for extending its lines to the outlying districts of Greensboro, and laying conduits along West Market Street in Greensboro, to cost from $60,000 to $100,000.

HOMERVILLE, GA.—The Ware County Light & Power Company, Waycross, plans to build a local substation to cost about $20,000.

SOPERTON, GA.—The local electric distribution system has been purchased by the Georgia Southern Power Company, Dublin. Service will eventually be supplied from a transmission line now being erected from Dublin through Soperton to Vidalia.

BELLEAIR, FLA.—Plans are being prepared by the Pinellas County Power Company, St. Petersburg, for the installation of an ornamental street-lighting system, totaling about 360 units.

HUNTINGDON, TENN.—The Kentucky-Tennessee Light & Power Company, Bowling Green, Ky., plans to build a local substation, to cost about $20,000.

MEMPHIS, TENN.—Steps have been taken by the Chamber of Commerce for the installation of an ornamental lighting system on portions of Third Street and Broadway.

BIRMINGHAM, ALA.—Plans have been prepared by the Alabama Power Company for enlarging the Upper Tallahassee Dam, located on the Tallapoosa River, 7 miles below the Martin Dam development. It is proposed to raise the dam from 37 ft. to 57 ft. and to increase the capacity of the generating plant from 8,500 hp. to 50,000 hp., with provision for a third unit of 25,000 hp. if needed.

LOUISVILLE, MISS.—The Mississippi Power Company, Gulfport, contemplates the erection of another 44,000-volt transmission line from Louisville to Philadelphia, a distance of about 25 miles. The plans also include a substation.

PERRYTON, MISS.—The town has voted to sell the municipal electric plant to the Inland Utilities Company.

HOT SPRINGS, ARK.—Plans are under way by the Dierks Lumber & Coal Company, 700 Gates Building, Kansas City, Mo., for a lumber mill, machine shop, electric power plant, etc., to cost about $1,000,000. to be erected in a new town being established near here.

BATON ROUGE, LA.—Bids will be received by the Louisiana Highway Commission, Reymond Building, Baton Rouge, until Feb. 10 for construction of the Moncla Ferry Bridge over Red River, including a drawbridge power plant and operator's house.

BUNKIE, LA.—The Louisiana Ice & Utilities, Inc., has acquired franchises for electric light service in the towns of Mansura, Le Compte, Evergreen, Plaucheville, Moreauville, Simmesport and Cottonport, all of which are in the vicinity of its central power station in Bunkie, and which will be connected by transmission lines.

LAKE CHARLES, LA.—Plans for the proposed local refinery of the Louisiana Oil Refining Company to cost about $1,500,000, include a power plant.

LECOMPTE, LA.—The Louisiana Ice & Utilities Company, Security Building, St. Louis, has purchased the municipal electric plant, and contemplates extensions in its transmission system in this section.

CHICHASHA, OKLA.—Franchises have been granted the Chickasha Gas & Electric Company in Gracemont, Binger and Lookeba. The company plans to erect a high-tension line from Verden to Anadarko.

DALLAS, TEX.—The Dallas Power & Light Company has applied to the City Council of University Park, a suburb of Dallas, for a franchise to install an electric distribution system to furnish service there. The City Council has asked the Dallas company to submit bids for the installation of ornamental lamps through St. Andrew's Place and Windsor Place.

EL PASO, TEX.—Extension and improvements involving an expenditure of about $1,000,000 during 1927 are contemplated by the El Paso Electric Company. The work will include the installation of two high-pressure boilers of 1,500 hp. each, improvements to substation, underground systems, etc.

HARLINGEN, TEX.—Plans for the proposed local mill to be erected by the Valley Cotton Mill Company, at a cost of about $300,000, include a power plant.

HOUSTON, TEX. — Work has been started by the Houston Lighting & Power Company on a substation at the intersection of the ship channel and the Houston Belt and Terminal Railway, to cost about $250,000.

MINERAL WELLS, TEX.—The Texas Power & Light Company, Dallas, is considering the erection of a 60,000-volt, steel-tower transmission line from Fort Worth to Mineral Wells. The proposed line will serve several towns between Fort Worth and Mineral Wells.

ORANGE, TEX.—Surveys are being made by the Gulf State Utilities Company for a proposed high-tension transmission line from Baton Rouge to Opelousas. As yet nothing definite has been decided as to the time when the line may reach Baton Rouge.

Pacific and Mountain States

ABERDEEN, WASH.—Plans for the proposed local sulphite pulp mill of the Crown-Willamette Paper Company, San Francisco, to cost about $5,000,000, include an electric substation.

ABERDEEN, WASH.—The Grays Harbor Railway & Light Company has applied for water rights and for permission to build a reservoir on Fry Creek for manufacturing purposes. The cost of the work is estimated at $20,000.

BELLINGHAM, WASH.—The Commissioners of Whatcom County have granted the Puget Sound Power & Light Company, Seattle, a franchise to extend its transmission lines over a number of roads in the county, now without electrical service.

ELLENSBURG, WASH.—Extensions to the municipal electric light plant is under consideration by the City Council.

HOQUIAM, WASH.—The City Council is considering the installation of an ornamental lighting system on Bay Avenue.

VANCOUVER, WASH.—The City Council is considering the installation of an improved street-lighting system in the downtown section.

FRESNO, CAL.—The City Council is considering the installation of ornamental lamps on Belmont Avenue, to cost about $11,500.

LONG BEACH, CAL.—Work on the installation of the first 100,000-kw. of the new Long Beach steam plant No. 3 of the Southern California is to begin at once. Present plans call for the eventual installation of eight such units, making a total capacity of 937,500 kw. Orders have been placed for a large portion of the equipment. Electricity generated at the plant will be transmitted over two new 220,000-volt steel-tower transmission lines to connect with the present 220,000-volt system.

LOS ANGELES, CAL.—The City Council has authorized the installation of ornamental lamps on portions of Mount Royal Drive, Eagle Dale Avenue, Third Street, and on Kilkea Drive, using concrete standards.

LOS ANGELES, CAL.—Extensions involving an expenditure of $42,000,000 are planned by the Southern California Edison Company during 1927. This includes the new 100,000-kw. unit for the Long Beach power station. The fifth power plant of the Big Creek-San Joaquin series in the High Sierras, on which work is to be started, and the northern end of the Vincent transmission line will be pushed to connect near Bakersfield with the southern end. Substations totaling seventy-five, will be built or their capacities materially increased, during the coming year. These substations and the lines distributing from them and other miscellaneous improvements throughout the system, will cost about $16,000,000.

PASADENA, CAL.—The City Council has authorized the installation of ornamental lamps on Nithsdale Road and on Sierra View Road.

PASADENA, CAL.—Plans are under consideration by the Light and Power Department for the installation of an additional 15,000-kw. generating unit in the municipal electric plant.

SACRAMENTO, CAL.—The City Council is considering the installation of ornamental lamps on Twenty-ninth Street. A. J. Wagner is city engineer.

VENTURA, CAL.—At an election held recently the proposal to issue $50,000 in bonds for the installation of a fire-alarm system was defeated.

MORGAN, UTAH—The installation of a new street-lighting system in Morgan is under consideration.

FAIRMONT, MONT.—Plans are being considered by the Montana-Dakota Power Company for the erection of a transmission line between McGregor and Genora; Plentywood and Scobey, with possible extension to Outlook and Whitetail, covering a distance of about 150 miles.

SHERIDAN, WYO.—Bids will be received by the Construction Division, Veterans' Bureau, Washington, D. C., until Jan. 25, for the installation of a fire alarm system in hospital No. 86.

ESTES PARK, COLO.—The City Council is considering the installation of an improved lighting system on Elkhorn Avenue, Riverside Parkway and Virginia Drive. Charles F. Hix is clerk.

FORT COLLINS, COL.—The City Council is considering the installation of an ornamental lighting system on West Oak Street.

RIFLE, COL.—The Public Service Company of Colorado, Denver, which has acquired the local plant has applied for permission to serve Rifle with electricity.

Canada

NANTON, B. C.—The local power plant was recently destroyed by fire, causing a loss of about $20,000.

QUEBEC, QUE.—Permission has been granted the Des Quinze Power Company to erect a transmission line to the Alderson Mackay properties.

QUEBEC, QUE.—The Des Quinze Power Company has applied for permission to erect a 12,000-volt transmission line to the Waite-Montgomery mine. The proposed line will be about 8 miles long and will pass through the towns of Rouyn, Dufresnoy and Dupray.

Electrical Patents

Announced by U. S. Patent Office

(Issued Dec. 14, 1926)

1,610,261. STORAGE-BATTERY CONSTRUCTION; T. S. Cole, New Haven, Conn. App. filed Sept. 5, 1923.

1,610,271. TEMPERATURE DETECTOR; D. D. Evins, Davenport, Iowa. App. filed Aug. 25, 1924. For rapid and accurate determination of surface temperatures, for instance, of the human body.

1,610,279. RELAY; C. F. Gilchrist, Toledo, Ohio. App. filed Oct. 11, 1920. Reverse-current relay or cut-out as commonly used in the battery-charging circuit of auto-vehicles.

1,610,280, 1,610,281. WINDING MACHINE; M. B. Grout, Chicago, Ill. Apps. filed Oct. 16, 1924, and July 17, 1925. For winding material, such as a strand of wire, into electromagnet coils.

1,610,297. VIBRATORY CONVERTER; O. M. Leich, Genoa, Ill. App. filed Dec. 31, 1921. Adapted for charging a storage battery and is provided with means for preventing discharge of the storage battery through the converter,

1,610,304. METER; E. L. Mabie, Chicago, Ill. App. filed April 24, 1926. Ammeter adapted to be arranged on instrument boards or mounting plates as of radio sets or the like by a detachable plug and socket connection.

1,610,310. GELATINOUS ELECTROLYTE; C. Ortill, New York, N. Y. App. filed Sept. 6, 1923. For galvanic cells and batteries.

1,610,386. PLUNGER-SWITCH MECHANISM; L. Meunier, Cleveland, Ohio. App. filed July 17, 1925. Switch utilizing a rotary block engaged by spring contacts.

1,610,442. STUFFING BOX; W. S. Gorton, London, England. App. filed Feb. 26, 1924. For use in connection with the testing of electrical conductors under the conditions of extreme humidity and pressure.

1,610,455. METHOD AND APPARATUS FOR CONTROLLING ELECTRIC MOTORS; J. D. Lewis, Yonkers, N. Y. App. filed Sept. 2, 1920. Methods and apparatus for varying the speed of induction-type motors.

1,610,456. SQUIRREL-CAGE MOTOR; D. L. Linquist, Hartsdale, N. Y., and J. D. Lewis, Yonkers, N. Y. App. filed May 18, 1923. Multi-speed squirrel-cage induction motors with improved end ring.

1,610,479. SWITCH-HOUSING STRUCTURE; W. M. Scott, Tredyffrin Township, Chester County, Pa. App. filed Dec. 19, 1923.

1,610,483. UNIVERSAL LIGHTING FIXTURE; W. T. Blackwell, Westfield, N. J. App. filed Oct. 27, 1921. Semi-indirect.

1,610,492 THREE-PHASE SHELL-TYPE TRANFORMER; H L Cole, Wilkinsburg, Pa. App. filed Aug. 6, 1923. A core structure for an electrical transformer in which the quantity of metal in the core structure is materially reduced.

1,610,506. INDUCTION MOTOR; G. H. Fletcher, Ashton-on-Mersey, England. App. filed June 29, 1922. With good starting characteristics which depend on eddy currents generated in the motor.

1,610,509. HEAT-CONTROL SWITCH; F. F. Forshee, Flint, Mich. App. filed March 24, 1921. Quick-break switch electromagnetically operated and which has but one actuating coil.

1,610,512. DISCONNECTING SWITCH AND SUPPORTING MEANS THEREFOR; L. R. Golladay, Wilkinsburg, Pa. App. filed April 12, 1921. Of the section-insulator type, in combination with a supporting member that serves as both a hanger and a strain insulator.

1,610,522. COMBINED FREQUENCY CHANGER AND PHASE CONVERTER; R. E. Hellmund, Swissvale, Pa. App. filed April 26, 1923. Particularly adapted for use upon electric railway locomotives.

1,610,546. ELECTRICAL TRANSMITTING DEVICE; F. A. Brandecker, Vallejo, Cal. App. filed March 15, 1923. A device adapted to transmit the reading of an indicating device to a second indicating device disposed at a distance therefrom.

1,610,557. ELECTRICAL MEASURING INSTRUMENT; P. Kriesel, Newark, N. J. App. filed May 12, 1923. Meter-supporting means for the operating shafts.

1,610,552. RELAY; H. D. James, Edgewood Park, Pa. App. filed Dec. 22, 1919. Thermal relay.

1,610,555. VOLTAGE-REGULATOR SYSTEM; C. H. Kindl, Pittsburgh, Pa. App. filed March 1, 1920. With one of the main contact members maintained in constant rotation and provided with a spirally arranged contact surface, the other main contact member engages the rotary contact member at a plurality of points and is operated in accordance with the value of the voltage obtaining in a supply circuit the voltage of which is to be regulated. The contact members serve to short-circuit a resistor which is included in the field-magnet-winding circuit of a generator connected to the supply circuit.

1,610,565. METER STRUCTURE; P. MacGahan, Pittsburgh, Pa. App. filed May 24, 1923. With damping and supporting means for the operating mechanisms.

1,610,566. ELECTRICAL MEASURING INSTRUMENT; P. MacGahan, Pittsburgh, Pa. App. filed Feb. 20, 1924. Thermoammeters and voltmeters. A measuring instrument in which both elements of a device for deriving a secondary current from a main current shall be carried by a movable element, responsive to the secondary current, to eliminate connections between stationary and movable points in the secondary-current circuit.

1,610,590. AUTOMATIC CIRCUIT INTERRUPTER; M. E. Reagan, Pittsburgh, Pa. App. filed March 24, 1921. Sectionalizing switch. With means for disconnecting a faulty section of a circuit embodying a plurality of sections connected to a source of energy.

1,610,591. LIQUID LEVEL INDICATOR; M. H. Redman, Dayton, Ohio. App. filed April 18, 1924. In which a combined magnetic and electrical circuit is utilized for the remote indication of the level of the liquid in the container.

1,610,616. ELECTRIC WELDING APPARATUS; A. H. Schlaf, Yonkers, N. Y. App. filed Oct. 21, 1921. Spot-welding type, as used more especially for welding the end rings to the rotor bars of an induction motor of the squirrel-cage type.

1,610,625. METERING SYSTEM; B. H. Smith, Swissvale, Pa. App. filed April 29, 1924. Adapted to transmit meter indications over long distances.

1,610,628. SPEED-REGULATOR SYSTEM; S. A. Staege, Pittsburgh, Pa. App. filed Feb. 14, 1921. Adapted to maintain a substantially constant-speed ratio between a plurality of moving members.

1,610,629. FLOAT-OPERATED CIRCUIT CLOSER FOR OIL-LEVEL-ALARM DEVICES; D. Steiner, Olympia, Wash. App. filed May 28, 1925.

1,610,634. SYSTEM OF CONTROL; W. E. Thau, Pittsburgh, Pa. App. filed March 15, 1923. Protection and operation of control systems that are employed in connection with the propulsion of ships and the like.

1,610,666. MULTIPLE MOTOR; W. Farrell, Philadlephia, Pa. App. filed July 27, 1923. Has maximum power capacity and minimum size.

1,610,672. TIME SWITCH; J. A. Gerstenfeld, New York, N. Y. App. filed July 5, 1923. A time-controlled device independent of an electric or other switch and adapted to be associated with and to operate such switch.

1,610,676. ELECTRIC SWITCH; G. H. Hart, West Hartford, Conn. App. filed Jan. 16, 1924. Wherein damage to or destruction of the contact members, owing to the contacts pounding or improperly striking one another when brought into engagement, and to arcing when the circuit is broken, is substantially eliminated.

1,610,702. LIGHTING FIXTURE; E. F. Oliver, Jersey City, N. J. App. filed Sept. 5, 1924. Having means whereby a color medium may be readily associated with an ordinary electric bulb, even when situated within a reflector or an inclosing element, and whereby the color medium may be quickly changed so as to obtain different colors at different times.

1,610,744. ELECTROMAGNET; E. R. Carichoff, Schenectady, N. Y. App. filed Feb. 18, 1922. Operating electromagnet for electric switches and the like.

1,610,751. ELECTRIC BOILER AND METHOD OF OPERATION; C. Dantsizen, Schenectady, N. Y. App. filed Feb. 19, 1924.

1,610,779. SIGNALING APPARATUS; J. R. Hewett, Schenectady, N. Y. App. filed Aug. 27, 1918. Submarine-signaling device automatically operated by the receipt of sound waves to transmit any desired form of signal.

1,610,809. ELECTRIC FURNACE; D. F. Newman, Schenectady, N. Y. App. filed Feb. 15, 1926. In which the operations are carried out in the presence of a selected gas, such as hydrogen, for example.

1,610,816. ALTERNATING-CURRENT MOTOR; P. H. Rutherford, Lynn, Mass. App. filed Feb. 9, 1925. Squirrel-cage rotors and a method of making such rotors.

1,610,819. ELECTRIC FURNACE; C. Steenstrip, Schenectady, N. Y. App. filed Feb. 15, 1926. In which the operations are carried out in the presence of a selected gas, such as hydrogen, for example.

1,610,851. ELECTRIC BROILER STRUCTURE; K. Ehrgott, Erie, Pa. App. filed Sept. 12, 1925. With removable elements.

1,610,867. TRANSFORMER; J. S. Lennox, Pittsfield, Mass. App. filed Sept. 18, 1923. With means for reducing the losses due to the stray magnetic flux, thus increasing the efficiency of the transformer and eliminating or reducing the heating effect of this stray flux. These results are attained by providing suitable auxiliary return paths for the stray magnetic flux.

1,610,892. ELECTRIC GAS LAMP WITH FLOW DISCHARGE; F. Skaupy, Berlin, H. Ewest, Berlin-Lichtenberg; A. Fehse, Berlin, and G. Galdies, Berlin-Pankow, Germany. App. filed May 23, 1921.

1,610,903. INSULATED TERMINAL FOR ELECTRICAL APPARATUS; H. Trencham, Ruislip, England. App. filed July 29, 1920. As transformers. A terminal which will prevent discharges taking place, and to that end it consists in providing a combined metal sheath and bushing, the sheath being connected to a terminal within the bushing and placed so as to surround the terminal and project beyond it.

1,610,915. THERMOSTATIC ELECTRIC SWITCH; J. M. Allen, St. Louis, Mo App. filed Nov. 2, 1925.

1,610,920. ELECTRIC ARC-WELDING OR CUTTING PROCESS; J. Bethenod, Paris, France. App. filed Jan. 5, 1926. An electric arc-welding process in which the energy supplied by a polyphase circuit is utilized directly, the load being equally distributed among all the phases. In principle this process consists in employing a plurality of independent arcs produced by means of a polyphase source between the parts to be welded together (or to be cut) and electrodes arranged next to, but insulated from, each other.

1,610,932. ELECTRIC HEATING DEVICE FOR BURNING AND DRYING PURPOSES; W. Cooper, Huddersfield, England. App. filed April 24, 1926.

1,610,971. ELECTROCHEMICAL TESTING DEVICE; S. Ruben, New York, N. Y. App. filed June 1, 1921. For testing the electrical properties of various substances, particularly liquids, by means of which other properties, such as the acidity of a liquid, can be determined.

1,611,014. CORD TERMINAL; W. A. Frantz, Cleveland, Ohio. App. filed Sept. 19, 1923.

1,611,044. VAPOR ELECTRIC LAMP; F. A. King, Hither Green, London, and F. Reynolds, Walkerville-on-Tyne, England. App. filed May 12, 1922.

1,611,049. COMBINED FAN AND HEATER; W. J. Lassonde, St. John, N. D. App. filed June 25, 1924.

1,611,086. GENERATOR REGULATION; R. H. Sullivan, Rochester, N. Y. App. filed Feb. 6, 1926. Regulator of the vibratory electromagnetic type, such as is used in connection with shunt-wound electric generators to maintain a substantially constant voltage of output; using a single individual winding on the magnet of the regulator.

1,611,091. ELEVATOR-CONTROL SYSTEM; R. J. Wensley, Pittsburgh, Pa. App. filed March 16, 1923.

1,611,102. MOTOR OVERLOAD CUT-OUT; G. C. De Bell, Winnipeg, Manitoba, Canada. App. filed March 20, 1924. Means associated wtih the motor which will automatically cut off the source of electric current supply to the motor, should the motor, under running conditions, become overloaded.

1,611,103. ALTERNATING-CURRENT ELECTRICITY METER; S. Z. de Ferranti, Hollinwood, England. App. filed Feb. 28, 1924. Means for the compensation of variation in braking effect of the series field.

1,611,107. AIR-HEATING PLANT; W. Doherty, West Philadelphia, Pa. App. filed May 21, 1926. Having a housing thoroughly covered with non-conducting material and having therein a large electric heating coil which is suitably connected with a source of supply for heating the air in the interior of the device, with means for conducting the heated air to the point of use.

(Issued Dec. 21, 1926)

1,611,153. DRY CELL AND PROCESS OF MAKING THE SAME; R. C. Benner, Bayside, N. Y., and H. W. Jones, Flushing, N. Y. App. filed Nov. 21, 1923. Dry cell of the flat type, embodying a shallow container which forms one electrode of the cell.

Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business

Pacific States Have High Energy Consumption per Customer

THE Pacific Coast States, and particularly the localities on the Southern coast, have for a number of years been notable for their large use of electrical energy in proportion to population and for the unusually high ratio between number of customers and number of inhabitants. Indeed, in this latter respect published data have at times been called in question because they indicate the existence of more domestic meters than the estimated number of families, when the latter are computed from population on the basis of national average for the number of persons in a family—a fallacious method, incidentally, when applied to a specific region in which "average" conditions do not necessarily prevail.

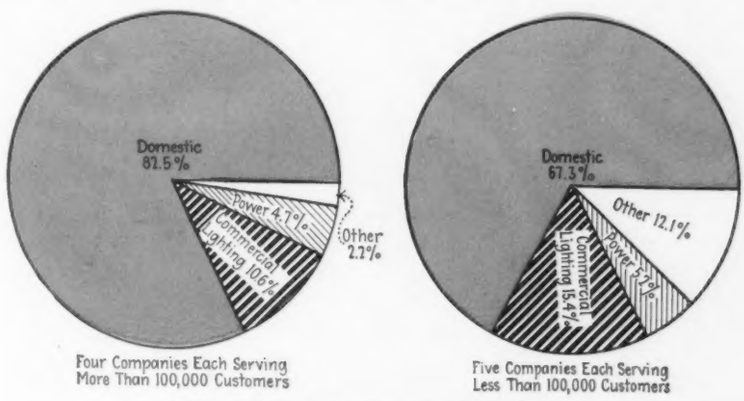
Thus, in certain parts, it seems to be definitely established, after checking back, that the number of such customers approaches one for every three inhabitants. The average for California as a whole is one for 3.5, whereas the national average is one for 7.4, and even in the thickly settled Eastern States, with their high ratio of urban population, the average is only one customer per 5.5 persons.

The relatively large energy consumption per consumer on the Western coast is indicated in one of the charts, which represents data for about 70 per cent of the total number of customers in the states under consideration, and applies to conditions at the beginning of 1926. It will be seen that one of the companies in the group of those having more than 100,000 customers had an average sale of 775 kw.-hr. per domestic customer; another sold 635 kw.-hr. With the smaller companies the range is less wide, but here, too, the average is still fairly high. The size of the company seems to make little difference.

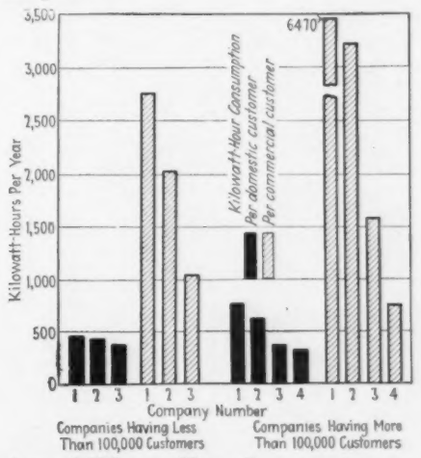
A noteworthy feature is the energy consumption by commercial lighting customers, which in one instance runs up to nearly 6,500 kw.-hr. per year and in all but one of the cases analyzed exceeds 1,000 kw.-hr. These values, it should be observed, are not accounted for by taking the average of a few big consumers; no fewer than 17,000 commercial lighting customers are reported by any company in the second group on the chart. The proportion of various kinds of customers has not been worked out for the region as a whole, but is shown for California alone, partly in order to bring out one somewhat unusual fact. It will be seen that the customers are divided into four major groups and that there is an exceptionally large number of other than lighting and industrial power users. These "other" users do not appear elsewhere in the United States except in the form of an insignificantly small, though highly important, percentage. They seem to be chiefly agricultural, using energy largely for irrigation and taking, on the average, some 20,000 kw.-hr. each per year.

Finally, the rate of increase in the Coast division as a whole appears to range within narrower limits than in other parts of the country; in number of domestic customers there are no strikingly high gains, nor is the opposite true. The commercial lighting gains reach higher values than the domestic, and it would appear that special progress is being made in adding to the "other" group, which, as is shown in the preceding diagrams, is an important element, not only numerically, but in point of energy consumption.

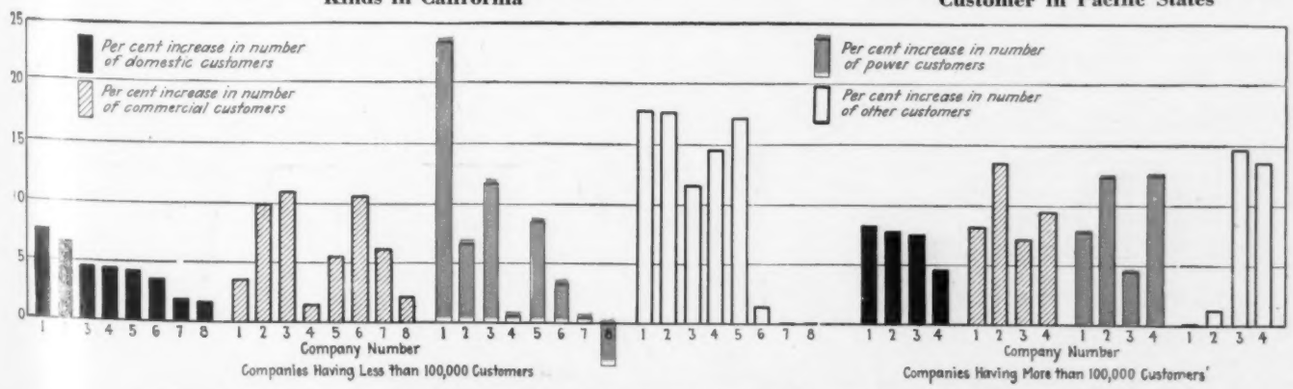
Most of the data for statistics in the ELECTRICAL WORLD are gathered by it from original sources. Privilege is freely given to readers of the ELECTRICAL WORLD to quote for use these statistics for any legitimate purpose. While there is no requirement that the source of data be given, yet it would help the ELECTRICAL WORLD in obtaining and compiling further basic information if those who make use of these statistics would give credit to the ELECTRICAL WORLD.



Proportion of Customers of Various Kinds in California



Annual Kilowatt-Hour Consumption per Customer in Pacific States


Per cent increase in number of domestic customers
Per cent increase in number of commercial customers
Per cent increase in number of power customers
Per cent increase in number of other customers
Company Number
Companies Having Less than 100,000 Customers
Company Number
Companies Having More than 100,000 Customers

Increasing Number of Customers of Typical Central-Station Companies in the Western States

Seasonal Industrial Recession in Western States

A SLIGHT seasonal decrease in industrial activities was apparent in the Western States during November. In the Mountain States a gradual decrease in virtually all outdoor seasonal activities and employment was noted, with indications of a further slackening during December. Industrial activities and employment, however, not affected by seasonal fluctuations remained steady. Taking industry as a whole, the recession in industrial operations which started in September was continued through October and November, the operations during these months, however, being well above those reported for the same month of last year. Such is the present status of industrial operations in the Western States as indicated by reports received by the ELECTRICAL WORLD on electrical energy consumption by some 400 large manufacturing plants.

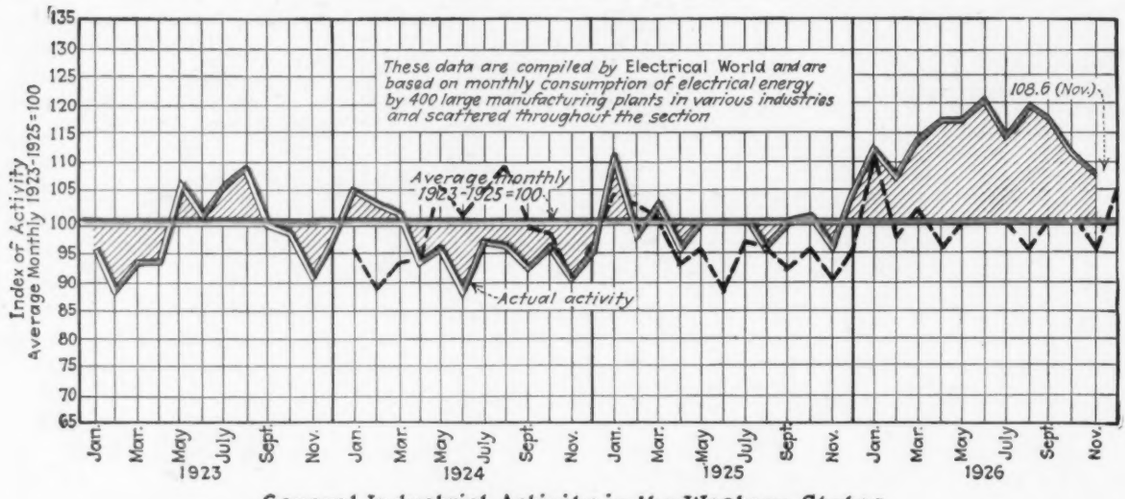
The month of November witnessed a further recession in all the six outstanding industries of the Western States. Industry in general was operating during November at 3 per cent under October and 9.3 per cent under July operations. November operations, however, were about 14 per cent over November of last year and 8.6 per cent over the monthly average for the past three years. There appears to have been no usual summer rest in trade during the year 1926 as far as the Western States are concerned, but this high rate of activity during the summer appears to have been nation-wide.

Operations in the food industry in the Western States are witnessing their usual recession for this season of the year. Practically all food and vegetable canneries throughout the section have ceased operations. November operations in the food industry were 3.3 per cent under those of October, but were about 12 per cent over those of November, 1925.

The present tendency of the logging and lumber industry is toward lessened production, the November operations being slightly below those of October but 8 per cent over those of November, 1925. It is probable that, owing to the elimination of the housing shortage throughout the country, operations in the lumber industry will continue to decline during the coming months.

"Electrical World" Barometer of Industrial Activity in the Western States

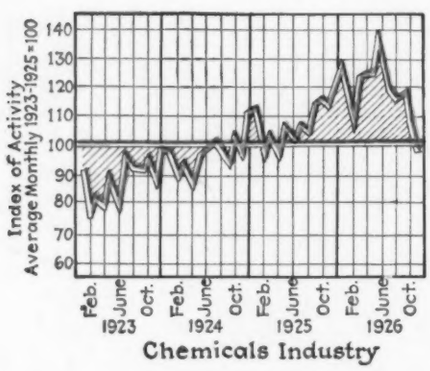
(Data Unadjusted for Seasonal Variation)



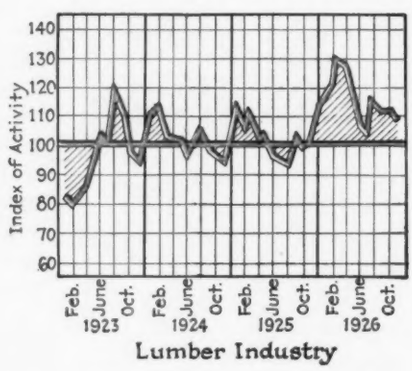
States in **Western** *Group*

Montana
Idaho
Wyoming
Colorado
New Mexico
Arizona
Utah
Nevada
Washington
Oregon
California

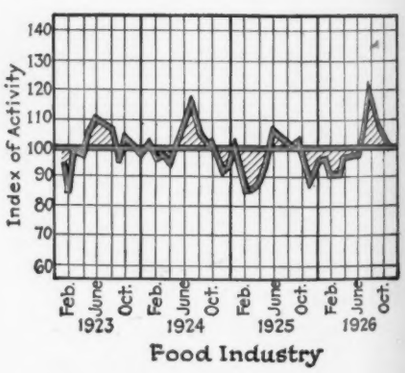
General Industrial Activity in the Western States



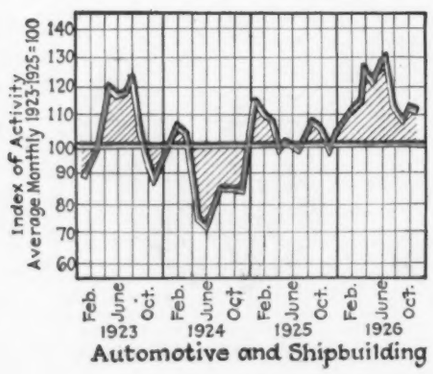
Chemicals Industry



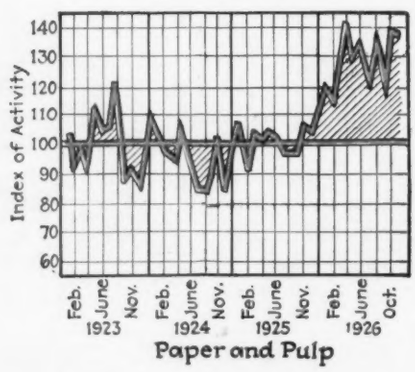
Lumber Industry



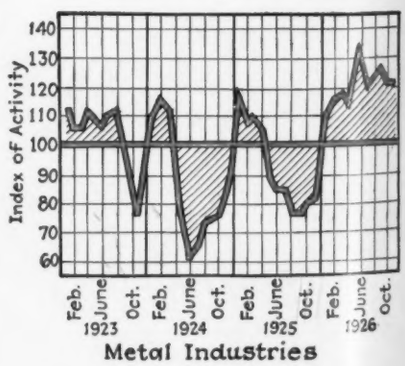
Food Industry



Automotive and Shipbuilding



Paper and Pulp



Metal Industries